

## Agile

EtherCAT®  
Communication module  
CM-EtherCAT® / CM2-EtherCAT®  
Frequency inverter 230 V / 400 V





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## 1 General Information on the Documentation

For better clarity, the documentation of the frequency inverter is structured according to the customer-specific requirements.

The present manual was created in the German language. The German manual is the original version. Other language versions are translated.

### Quick Start Guide

The "Quick Start Guide" describes the basic steps required for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the configuration of the software of the frequency inverter.

### User manual

The user manual documents the complete functionality of the frequency inverter. The parameters required for special purposes, for adjustment to the application and the numerous additional functions are described in detail.

Separate user manuals are supplied for optional components for the frequency inverter. These manuals complement the operating instructions and the "Quick Start Guide" for the frequency inverter.

### Application manual

The application manual complements the documentation to ensure goal-directed installation and commissioning of the frequency inverter. Information on various topics in connection with the use of the frequency inverter is described in context with the specific application.

### Installation instructions

The installation manual describes the installation and use of devices, complementing the "Quick Start Guide" and the user manual.

#### 1.1 This document

The present user manual of the CM-EtherCAT® and CM2-EtherCAT® communication module complements the Operating Instructions and the "Quick Start Guide" for the frequency inverters of Agile device series.

The user manual contains important information on the installation and use of the EtherCAT® communication module CM-EtherCAT® in its specified application range. Compliance with this user manual contributes to avoiding risks, minimizing repair cost and downtimes and increasing the reliability and service life of the frequency inverter.

For this reason, make sure you read the user manual carefully.



EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.



#### WARNING

Compliance with the documentation is required to ensure safe operation of the frequency inverter. BONFIGLIOLI VECTRON GmbH shall not be held liable for any damage caused by any non-compliance with the documentation.



In case any problems occur which are not covered by the documentation sufficiently, please contact the manufacturer.

In this manual, the designation „CM-EtherCAT®“ also applies to CM2-EtherCAT® modules.

## **1.2 Warranty and liability**

BONFIGLIOLI VECTRON GmbH would like to point out that the contents of this user manual do not form part of any previous or existing agreement, assurance or legal relationship. Neither are they intended to supplement or replace such agreements, assurances or legal relationships. Any obligations of the manufacturer shall solely be based on the relevant purchase agreement which also includes the complete and solely valid warranty stipulations. These contractual warranty provisions are neither extended nor limited by the specifications contained in this documentation.

The manufacturer reserves the right to correct or amend the specifications, product information and omissions in these operating instructions without notice. The manufacturer shall not be liable for any damage, injuries or costs which may be caused by the aforementioned reasons.

Furthermore, BONFIGLIOLI VECTRON GmbH excludes any warranty/liability claims for any personal and/or material damage if such damage is due to one or more of the following causes:

- inappropriate use of the frequency inverter,
- non-compliance with the instructions, warnings and prohibitions contained in the documentation,
- unauthorized modifications of the frequency inverter,
- insufficient monitoring of parts of the machine/plant which are subject to wear,
- repair work at the machine/plant not carried out properly or in time,
- catastrophes by external impact and force majeure.

## **1.3 Obligation**

This user manual must be read before commissioning and complied with. Anybody entrusted with tasks in connection with the

- transport,
- assembly,
- installation of the frequency inverter and
- operation of the frequency inverter

must have read and understood the user manual and, in particular, the safety instructions in order to prevent personal and material losses.



## 1.4 Copyright

In accordance with applicable law against unfair competition, this user manual is a certificate. Any copyrights relating to it shall remain with

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Germany

This user manual is intended for the operator of the frequency inverter. Any disclosure or copying of this document, exploitation and communication of its contents (as hardcopy or electronically) shall be forbidden, unless permitted expressly.

Any non-compliance will constitute an offense against the copyright law dated 09 September 1965, the law against unfair competition and the Civil Code and may result in claims for damages. All rights relating to patent, utility model or design registration reserved.

## 1.5 Storage

The documentation form an integral part of the frequency inverter. It must be stored such that it is accessible to operating staff at all times. If the frequency inverter is sold on to other users, then this user manual must also be handed over.

## 1.6 Final decommissioning

After the end of product service life, the user/operator must take the device out of operation.

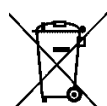


For more information about the decommissioning of the device refer to the applicable operating instructions document.

## Disposal requirements under European Union WEEE regulations

The product is marked with the WEEE symbol shown below.

This product cannot be disposed as general household waste. Users responsible for the final disposal must make sure that it is carried out in accordance with the European Directive 2012/19/EU, where required, as well as the relative national transposition rules. Fulfil disposal also in according with any other legislation in force in the country.



## 2 General safety instructions and information on use

The chapter "General safety instructions and information on use" contains general safety instructions for the Operator and the Operating Staff. At the beginning of certain main chapters, some safety instructions are included which apply to all work described in the relevant chapter. Special work-specific safety instructions are provided before each safety-relevant work step.

### 2.1 Terminology

According to the documentation, different activities must be performed by certain persons with certain qualifications.

The groups of persons with the required qualification are defined as follows:

**Operator**

This is the entrepreneur/company who/which operates the frequency inverter and uses it as per the specifications or has it operated by qualified and instructed staff.

**Operating staff**

The term Operating Staff covers persons instructed by the Operator of the frequency inverter and assigned the task of operating the frequency inverter.

**Skilled Personnel** The term **Skilled Personnel** covers staff that are assigned special tasks by the Operator of the frequency inverter, e.g. installation, maintenance and service/repair and troubleshooting. Based on their qualification and/or know-how, **Skilled Personnel** must be capable of identifying defects and assessing functions.

**Qualified electrician**

The term Qualified Electrician covers qualified and trained staff that has special technical know-how and experience with electrical installations. In addition, Qualified Electricians must be familiar with the applicable standards and regulations, they must be able to assess the assigned tasks properly and identify and eliminate potential hazards.

**Instructed person**

The term Instructed Person covers staff that was instructed and trained about/in the assigned tasks and the potential hazards that might result from inappropriate behavior. In addition, instructed persons must have been instructed in the required protection provisions, protective measures, the applicable directives, accident prevention regulations as well as the operating conditions and verified their qualification.

**Expert**

The term Expert covers qualified and trained staff that has special technical know-how and experience relating to the frequency inverter. Experts must be familiar with the applicable government work safety directives, accident prevention regulations, guidelines and generally accepted rules of technology in order to assess the operationally safe condition of the frequency inverter.

## **2.2 Designated use**

The frequency inverter is designed according to the state of the art and recognized safety regulations.

The frequency inverters are electrical drive components intended for installation in industrial plants or machines. Commissioning and start of operation is not allowed until it has been verified that the machine meets the requirements of the EC Machinery Directive 2006/42/EC and DIN EN 60204-1.

The frequency inverters meet the requirements of the low voltage directive 2014/35/EU and DIN EN 61800-5-1. CE-labeling is based on these standards. Responsibility for compliance with the EMC Directive 2004/108/EC lies with the operator. Frequency inverters are only available at specialized dealers and are exclusively intended for commercial use as per EN 61000-3-2.

No capacitive loads may be connected to the frequency inverter.

The technical data, connection specifications and information on ambient conditions are indicated on the rating plate and in the documentation and must be complied with at all times.

## 2.3 Misuse

Any use other than that described in "Designated use" shall not be permissible and shall be considered as misuse.

For example, the machine/plant must not be operated

- by uninstructed staff,
- while it is not in perfect condition,
- without protection enclosure (e.g. covers),
- without safety equipment or with safety equipment deactivated.

The manufacturer shall not be held liable for any damage resulting from such misuse. The sole risk shall be borne by the operator.

### 2.3.1 Explosion protection

The frequency inverter is an IP 20 protection class device. For this reason, use of the device in explosive atmospheres is not permitted.

## 2.4 Residual risks

Residual risks are special hazards involved in handling of the frequency inverter which cannot be eliminated despite the safety-compliant design of the device. Residual risks are not obviously identifiable and can be a potential source of injury or health hazard.

Typical residual hazards include:

### Electrical hazard

Danger of contact with energized components due to a defect, opened covers or enclosures or improper working on electrical equipment.

Danger of contact with energized components inside of the frequency inverter if no external disconnection device was installed by the operator.

### Electrostatic charging

Touching electronic components bears the risk of electrostatic discharges.

### Thermal hazards

Risk of accidents by hot machine/plant surfaces, e.g. heat sink, transformer, fuse or sine filter.

### Charged capacitors in DC link

The DC link may have dangerous voltage levels even up to three minutes after shutdown.

### Danger of equipment falling down/over, e.g. during transport

Center of gravity is not the middle of the electric cabinet modules.

## 2.5 Safety and warning signs on the frequency inverter

- Comply with all safety instructions and danger information provided on the frequency inverter.
- Safety information and warnings on the frequency inverter must not be removed.

## 2.6 Warning information and symbols used in the user manual

### 2.6.1 Hazard classes

The following hazard identifications and symbols are used to mark particularly important information:


**DANGER**

Identification of immediate threat holding a **high** risk of death or serious injury if not avoided.


**WARNING**

Identification of immediate threat holding a **medium** risk of death or serious injury if not avoided.






**CAUTION**

Identification of immediate threat holding a **low** risk of minor or moderate physical injury if not avoided.


**NOTE**

Identification of a threat holding a risk of material damage if not avoided.


## 2.6.2 Hazard symbols

Symbol	Meaning	Symbol	Meaning
	General hazard		Suspended load
	Electrical voltage		Hot surfaces


## 2.6.3 Prohibition signs

Symbol	Meaning
	No switching; it is forbidden to switch the machine/plant, assembly on


## 2.6.4 Personal safety equipment

Symbol	Meaning
	Wear body protection


## 2.6.5 Recycling

Symbol	Meaning
	Recycling, to avoid waste, collect all materials for reuse


## 2.6.6 Grounding symbol

Symbol	Meaning
	Ground connection

## 2.6.7 ESD symbol

Symbol	Meaning
	ESD: Electrostatic Discharge (can damage components and assemblies)

## 2.6.8 Information signs

Symbol	Meaning
	Tips and information making using the frequency inverter easier.

## 2.7 Directives and guidelines to be adhered to by the operator

The operator must follow the following directives and regulations:

- Ensure that the applicable workplace-related accident prevention regulations as well as other applicable national regulation are accessible to the staff.
- An authorized person must ensure, before using the frequency inverter, that the device is used in compliance with its designated use and that all safety requirements are met.
- Additionally, comply with the applicable laws, regulations and directives of the country in which the frequency inverter is used.
- Any additional guidelines and directives that may be required additionally shall be defined by the operator of the machine/plant considering the operating environment.

## 2.8 Operator's general plant documentation

- In addition to the user manual, the operator should issue separate internal operating instructions for the frequency inverter. The Operating Instructions of the frequency inverter must be included in the user manual of the whole plant.

## **2.9 Operator's/operating staff's responsibilities**

### **2.9.1 Selection and qualification of staff**

- Any work on the frequency inverter may only be carried out by qualified technical staff. The staff must not be under the influence of any drugs. Note the minimum age required by law. Define the staff's responsibility in connection with all work on the frequency inverter clearly.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering.
- The operating staff must be trained for the relevant work to be performed.

### **2.9.2 General work safety**

- In addition to the user manual of the machine/plant, any applicable legal or other regulations relating to accident prevention and environmental protection must be complied with. The staff must be instructed accordingly.  
Such regulations and/or requirements may include, for example, handling of hazardous media and materials or provision/use of personal protective equipment.
- In addition to this user manual, issue any additional directives that may be required to meet specific operating requirements, including supervision and reporting requirements, e.g. directives relating to work organization, workflow and employed staff.
- Unless approved of expressly by the manufacturer, do not modify the frequency inverter in any way, including addition of attachments or retrofits.
- Only use the frequency inverter if the rated connection and setup values specified by the manufacturer are met.
- Provide appropriate tools as may be required for performing all work on the frequency inverter properly.

## **2.10 Organizational measures**

### **2.10.1 General**

- Train your staff in the handling and use of the frequency inverter and the machine/plant as well as the risks involved.
- Use of any individual parts or components of the frequency inverter in other parts of the operator's machine/plant is prohibited.
- Optional components for the frequency inverter must be used in accordance with their designated use and in compliance with the relevant documentation.

### **2.10.2 Use in combination with third-party products**

- Please note that BONFIGLIOLI VECTRON GmbH will not accept any responsibility for compatibility with third-party products (e.g. motors, cables or filters).
- In order to enable optimum system compatibility, BONFIGLIOLI VECTRON GmbH offers components facilitating commissioning and providing optimum synchronization of the machine/plant parts in operation.
- If you use the frequency inverter in combination with third-party products, you do this at your own risk.

### **2.10.3 Transport and storage**

- The frequency inverters must be transported and stored in an appropriate way. During transport and storage the devices must remain in their original packaging.
- The units may only be stored in dry rooms which are protected against dust and moisture and are exposed to small temperature deviations only. The requirements of DIN EN 60721-3-1 for storage, DIN EN 60721-3-2 for transport and labeling on the packaging must be met.

- The duration of storage without connection to the permissible nominal voltage may not exceed one year.

#### **2.10.4 Handling and installation**

- Do not commission any damaged or destroyed components.
- Prevent any mechanical overloading of the frequency inverter. Do not bend any components and never change the isolation distances.
- Do not touch any electronic construction elements and contacts. The frequency inverter is equipped with components which are sensitive to electrostatic energy and can be damaged if handled improperly. Any use of damaged or destroyed components will endanger the machine/plant safety and shall be considered as a non-compliance with the applicable standards.
- Only install the frequency inverter in a suitable operating environment. The frequency inverter is exclusively designed for installation in industrial environments.
- If seals are removed from the case, this can result in the warranty becoming null and void.

#### **2.10.5 Electrical connections**

- The five safety rules must be complied with.
- Never touch live terminals. The DC link may have dangerous voltage levels even up to three minutes after shutdown.
- When performing any work on/with the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants of the country in which the frequency inverter is used.
- The cables connected to the frequency inverters may not be subjected to high-voltage insulation tests unless appropriate circuitry measures are taken before.
- Only connect the frequency inverter to suitable supply mains.

##### **2.10.5.1 The five safety rules**

When working on/in electrical plants, always follow the five safety rules:

1. Isolate
2. Secure to prevent restarting
3. Check isolation
4. Earth and short-circuit,
5. Cover or shield neighboring live parts.

#### **2.10.6 Safe operation**

- During operation of the frequency inverter, always comply with the applicable national and international regulations/laws on work on electrical equipment/plants.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to the applicable national and international safety directives.
- During operation, never open the machine/plant
- Do not connect/disconnect any components/equipment during operation.
- The machine/plant holds high voltage levels during operation, is equipped with rotating parts (fan) and has hot surfaces. Any unauthorized removal of covers, improper use, wrong installation or operation may result in serious injuries or material damage.
- Some components, e.g. the heat sink or brake resistor, may be hot even some time after the machine/plant was shut down. Don't touch any surfaces directly after shutdown. Wear safety gloves where necessary.
- The frequency inverter may hold dangerous voltage levels until the capacitor in the DC link is discharged. Wait for at least 3 minutes after shutdown before starting electrical or

mechanical work on the frequency inverter. Even after this waiting time, make sure that the equipment is deenergized in accordance with the safety rules before starting the work.

- In order to avoid accidents or damage, only qualified staff and electricians may carry out the work such as installation, commissioning or setup.
- In the case of a defect of terminals and/or cables, immediately disconnect the frequency inverter from mains supply.
- Persons not familiar with the operation of frequency inverters must not have access to the frequency inverter. Do not bypass nor decommission any protective facilities.
- The frequency inverter may be connected to power supply every 60 s. This must be considered when operating a mains contactor in jog operation mode. For commissioning or after an emergency stop, a non-recurrent, direct restart is permissible.
- After a failure and restoration of the power supply, the motor may start unexpectedly if the Auto Start function is activated.  
If staff are endangered, a restart of the motor must be prevented by means of external circuitry.
- Before commissioning and the start of the operation, make sure to fix all covers and check the terminals. Check the additional monitoring and protective devices according to EN 60204 and applicable the safety directives (e.g. Working Machines Act or Accident Prevention Directives).

### **2.10.7 Maintenance and service/troubleshooting**

- Visually inspect the frequency inverter when carrying out the required maintenance work and inspections at the machine/plant.
- Perform the maintenance work and inspections prescribed for the machine carefully, including the specifications on parts/equipment replacement.
- Work on the electrical components may only be performed by a qualified electrician according to the applicable rules of electrical engineering. Only use original spare parts.
- Unauthorized opening and improper interventions in the machine/plant can lead to personal injury or material damage. Repairs on the frequency inverters may only be carried out by the manufacturer or persons authorized by the manufacturer. Check protective equipment regularly.
- Before performing any maintenance work, the machine/plant must be disconnected from mains supply and secured against restarting. The five safety rules must be complied with.

### **2.10.8 Final decommissioning**

Unless separate return or disposal agreements were made, recycle the disassembled frequency inverter components:

- Scrap metal materials
- Recycle plastic elements
- Sort and dispose of other component materials



Electric scrap, electronic components, lubricants and other utility materials must be treated as special waste and may only be disposed of by specialized companies.



Always comply with any applicable national disposal regulations as regards environmentally compatible disposal of the frequency inverter. For more details, contact the competent local authorities.



### 3 Introduction

The present document describes the possibilities and properties of EtherCAT® communication for the frequency inverters of the *Agile* series of devices.

EtherCAT® communication (as described in this manual) requires software version 6.1.0 or higher.

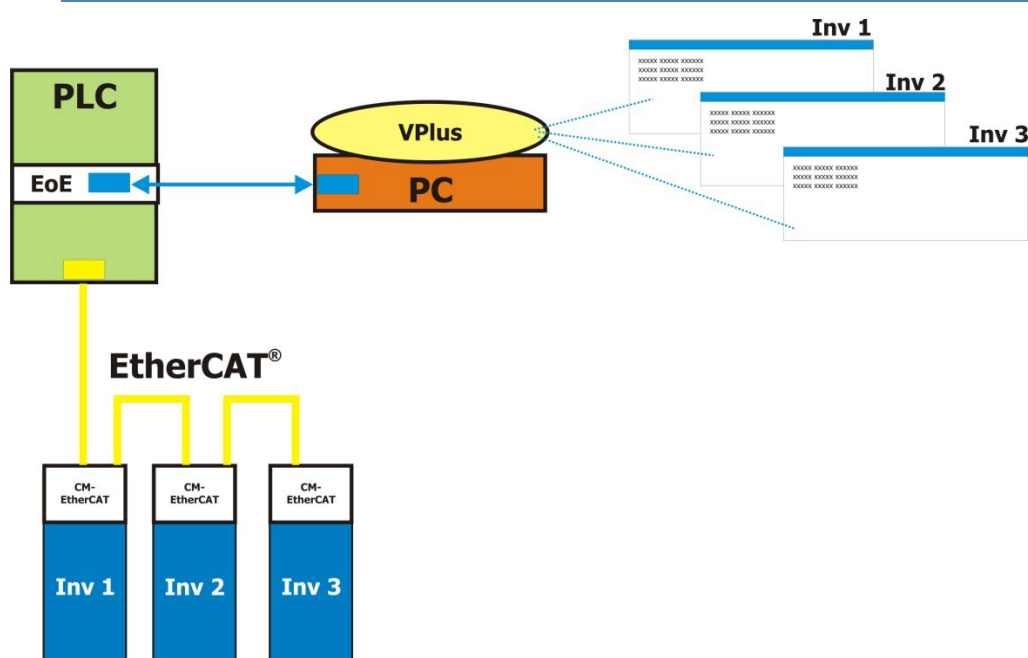


Please refer to 15.7 "Object support in software versions and XML files" for information on the required objects and XML files.



This manual is not to be understood as providing general/basic information on EtherCAT®. It requires basic knowledge of the methods and effects of EtherCAT® on the user's side.

In some chapters, setting and display options via the PC software VPlus are described as an alternative to the control panel. Use of a PCs running the VPlus software requires an optional interface adapter or EoE modules in the PLC for a direct Ethernet connection from the PC/VPlus to the frequency inverter.



In this document, the hardware circuitry, relevant parameters and the available objects are described.

The available objects are divided by:

Communication objects	(0x1nnn)
Manufacturer objects	(0x2nnn)
Standardized objects	(0x6nnn)

The functions and objects are described in this manual to the extent necessary. For more information, refer to the standards of EtherCAT Technology Group (ETG).

The standards referred to are available at:

**EtherCAT Technology Group**

**Headquarters**

**Ostendstr. 196**

**90482 Nürnberg, Germany**

**E-Mail:** [info@ethercat.org](mailto:info@ethercat.org)

**Web:** [www.ethercat.org](http://www.ethercat.org)

**Phone:** +49 (911) 5 40 56 - 20

**Fax:** +49 (911) 5 40 56 - 29

#### NOTE

With the CM-EtherCAT® communication module, it is possible to access **ALL** frequency inverter parameters from a controller. There is no access control via the control level as in the case of the control panel or the VPlus PC software. Changing parameters, the functions of which are not known to the user, can result in unintended movements and material and/or personal losses as well as inoperativeness of the frequency inverter.

#### NOTE

If values are to be written cyclically, follow the notes in Chapter 12.3.1 "Handling of datasets / cyclic writing".



For operation with a controller, a XML is required. The latest device description can be downloaded from the Bonfiglioli.com website.



Hexadecimal values are marked in the following by a preceding "0x".

### 3.1 Supported configurations

Agile frequency inverters support various types of control and reference point input:

- Contacts or remote contacts
- Statemachine

#### Contacts or remote contacts

Necessary settings: *Local/Remote 412* = (Remote) contacts

- ➔ The control (Start, Stop, Frequency change over, etc.) is carried out typically via:
  - Digital contacts
  - Remote contacts via Field bus
- ➔ Reference values result from the select configuration. Typical are:
  - Reference speed / Reference frequency:
    - Analogue input
    - Fixed values from parameters
    - [0x6042](#) vI Target velocity
  - Percentage reference value for technology controller or Torque control
    - Analogue input
    - Fixed values from parameters

See Chapter “13 Control of frequency inverter”.

#### Statemachine:

Necessary settings: *Local/Remote 412* = 1 – Statemachine

- ➔ Control (start, stop, change of mode, etc.) is performed via [0x6040](#) Control word:
- ➔ Reference values result from the select configuration. Typical are:
  - Reference speed / Reference frequency:
    - Analogue input
    - Fixed values from parameters
    - [0x6042](#) vI Target velocity
  - Percentage reference value for technology controller or Torque control
    - Analogue input
    - Fixed values from parameters

### 3.2 Initialization time

When the frequency inverter is turned on, the communication module must be initialized in addition to the frequency inverter. The initialization can take up to 20 seconds.



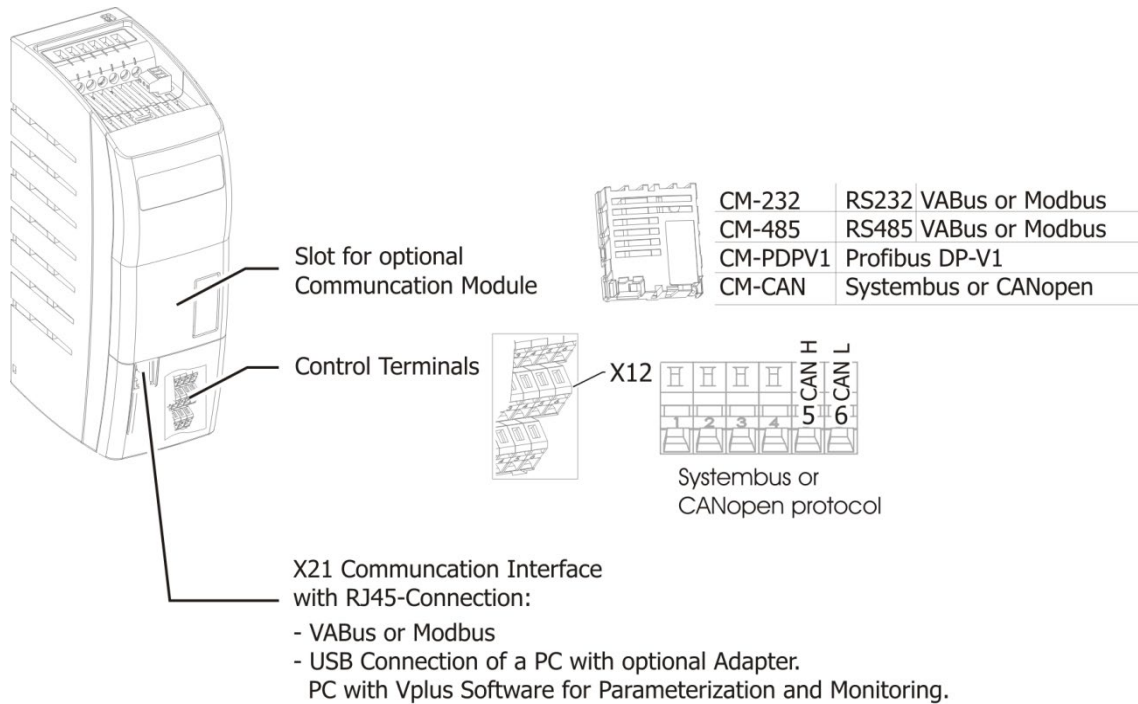
Wait until the initialization phase is complete before starting the communication (RUN LED).

## 4 First commissioning

For first commissioning, you should be familiar with the followings steps and the described functions:

- Installation of the Module Chapter 6.1
- Selection of device control *Local/Remote* **412** Chapter 13
- Commission the device function via PLC
  - PDO Mapping Chapter 12.2.9,  
12.2.10
  - Fault reaction Chapter 10,  
12.5.1
    - Fault reset Chapter 15.5,  
**Fehler! Verweisquelle konnte nicht gefunden werden.**
- Diagnosis: Chapter 13  
14

## 5 Communication options



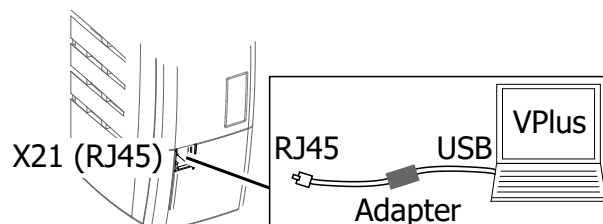
Interface	See
CAN connection control terminals CM-CAN	Instructions on Systembus or CANopen®.
Communication interface X21 CM-232	Instructions on VABus or Modbus
CM-485	Instructions on VABus or Modbus
CM-PDPV1	Instructions on Profibus DP-V1.
CM-DEV	Instructions on DeviceNet
CM-VABus/TCP	Instructions on VABus/TCP
CM- EtherCAT®	Instructions on EtherCAT®
CM-EtherNet/IP	Instructions on EtherNet/IP
CM-Modbus/TCP	Instructions on Modbus TCP
CM-PROFINET	Instructions on PROFINET

Combinations of System Bus and CANopen® communication at the two interfaces:

Optional communication module (CM)		Frequency inverter terminals X12.5 and X12.6
CANopen®	and (at the same time)	System Bus
System Bus	and (at the same time)	CANopen®

### 5.1 Control software VPlus

Via an optional USB adapter, you can connect an USB interface of a PC to the X21 communication interface. This enables configuration and monitoring using the PC software VPlus.



## 6 Assembly/disassembly of the communication module

### 6.1 Assembly

The CM-EtherCAT® communication module is delivered in a case for assembly. In addition, a PE-spring is supplied for PE-connection (shield).



#### CAUTION

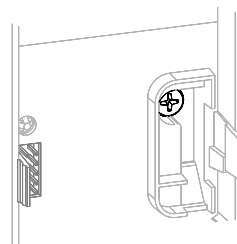
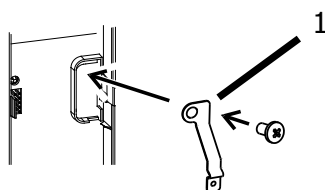
#### **Danger of destruction of frequency inverter and/or communication module**

The frequency inverter must be disconnected from the power supply before installation of the communication module. Assembly under voltage is not permissible.

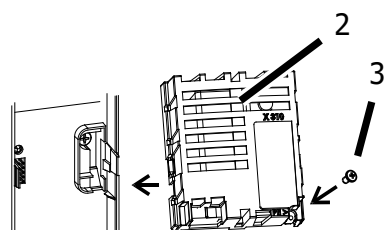
- Do not touch the PCB visible on the back of the module, otherwise components may be damaged.

#### **Work steps:**

- Disconnect the frequency inverter from mains voltage and protect it against being energized unintentionally.
- Remove the cover of the module slot.
- Fix the PE-spring (1). Use the screw provided at the frequency inverter.



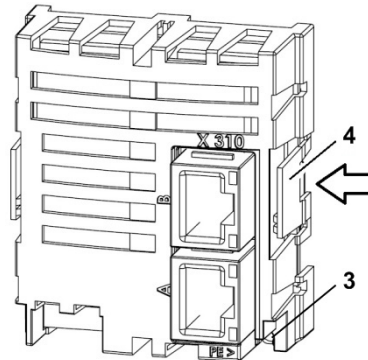
- Insert the communication module.
- Fix the communication module (2) at the frequency inverter using the screw (3).



- Break out the pre-punched cut-out from the cover.
- Fix the cover again.

## 6.2 Disassembly

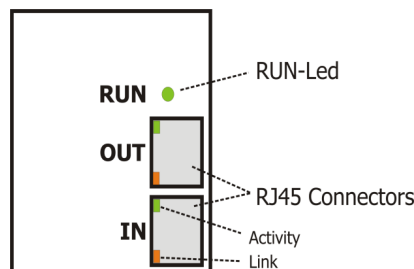
- Disconnect the frequency inverter from power supply and protect it against being energized unintentionally.
- Remove the cover of the module slot.
- Loosen the screw (3) on the communication module.
- Using a small screwdriver, unlock the hooks (4) (first right then left).



- Pull communication module out of slot.
- Unscrew PE-spring.
- Fix the cover on the frequency inverter.

## 7 Connector assignment

The CM-EtherCAT® module is connected to the PLC and/or other devices using standard Ethernet cables with RJ45 connectors.



### Ethernet standard:

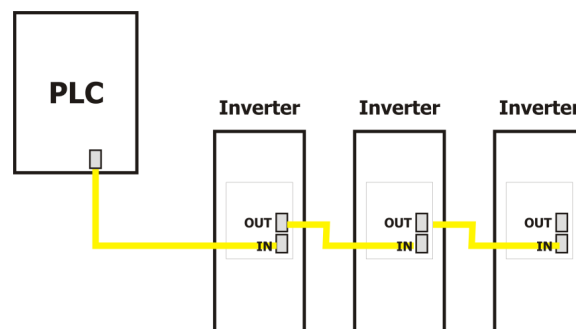
IEEE 802.3, 100Base-TX (fast Ethernet)

### Cable type:

S/FTP (cable with braided shield, (ISO/IEC 11801 or EN 50173, CAT5e Straight Through or Cross Over)

Connections from the PLC are connected to "IN".

Connections to the next device are connected to "OUT".



## 8 RUN LED

The green RUN LED indicates the current status of CM-EtherCAT®.

LED Status	Module status
Off	INITIALISATION
Flashing	PRE-OPERATIONAL
Single Flash	SAFE-OPERATIONAL
On	OPERATIONAL

## 9 Cable lengths

The cable length is restricted by the Ethernet specifications, cables must not exceed a length of 100 m.

### 9.1 Setting the node address

Adjustment of the node address is not required. The EtherCAT® master will set an unambiguous, singular 16-bit address for each device upon startup.

## 10 Operating behavior in the case of bus connection failure

The operating behavior in the case of failure of the EtherCAT® systems can be parameterized. The required behavior can be set via parameter *Bus Error Behaviour* **388**.

<i>Bus Error Behaviour</i> <b>388</b>	Function
0 - No Reaction	Operating point is maintained
1 - Error	Device state machine changes immediately to state "fault" ( <b>factory setting</b> )
2 - Switch-off	Device state machine processes command ' <i>disable voltage</i> ' and changes to state "switch on disabled"
3 - Quick-Stop	Device state machine processes command ' <i>quick stop</i> ' and changes to state "switch on disabled"
4 - Ramp-Stop + Error	Device state machine processes command ' <i>disable operation</i> ' and changes to state "fault" after the drive is stopped
5 - Quick-Stop + Error	Device state machine processes command ' <i>quick stop</i> ' and changes to state "fault" after the drive is stopped

### NOTE

The parameter settings *Bus Error Behaviour* **388** = 2...5 are evaluated depending on parameter *Local/Remote* **412**.

There are numerous options of parameterizing the fault and warning behavior of the frequency inverter. For details about possible faults, refer to Chapter 15.5 "Error messages".



## 11 EtherCAT® overview

EtherCAT® is used in a wide range of applications, preferably as a communication system for positioning applications. EtherCAT® supports the CANopen®-based standard DS402 “drives and motion control” (drives and positioning controls). This standard describes and defines the required objects and functions for positioning controllers.

Every EtherCAT® device contains an object dictionary with all supported objects. The objects can be divided into the two main groups – communication objects and application objects. The objects are addressed by their index 0xnnnn (16 bit) and sub-index 0xnn (8 bit).

### 11.1 Communication objects

The communication objects are located in the index range 0x1nnn. They describe the communication behaviour of an EtherCAT® device. Some of the communication objects comprise device information

(e. g. manufacturer’s vendor-id or inverter serial number). With the help of communication objects the application objects for device control are mapped to the PDO messages.

### 11.2 Application objects

Application objects are divided in two groups. Index range 0x2000 to 0x5FFF is reserved for manufacturer-specific objects, and index range 0x6nnn is reserved for specific device profile objects. The specific device profile objects 0x6nnn are defined by CANopen® DS402 “drive and motion control”. They are used for controlling device functions (Start/Stop, speed, positioning functions).

### 11.3 SDO function

The SDO (Service Data Objects) messages are used for reading and writing the objects located in the object dictionary.

#### 11.3.1 Table of error codes

If there is an error during the read/write operation, the server SDO of the frequency inverter will return the abort telegram.

Error codes			
Abort-code high	Abort-code low	Description as per CANopen®	Product-specific allocation
0x0601	0x0000	Unsupported access to an object	Parameter cannot be written or read
0x0602	0x0000	Object does not exist	Parameter does not exist
0x0604	0x0047	General internal incompatibility in the device	Data sets differ
0x0606	0x0000	Access failed due to a hardware error	EEPROM Error (Read/write/checksum)
0x0607	0x0010	Data type does not match	Parameter has a different data type
0x0607	0x0012	Data type does not match or length of service telegram too big	Parameter has a different data type or telegram length not correct.
0x0607	0x0013	Data type does not match or length of Service telegram too small	Parameter has a different data type or telegram length not correct.
0x0609	0x0011	Sub index does not exist	Data set does not exist
0x0609	0x0030	Value range of parameter exceeded	Parameter value too large or too small
0x0609	0x0031	Value of parameter written too high.	Parameter value too large
0x0609	0x0032	Value of parameter written too low.	Parameter value too small
0x0800	0x0020	Data cannot be transmitted or saved	Invalid value for operation
0x0800	0x0021	Data cannot be transferred because of local control	Parameter cannot be written in operation

## 11.4 PDO function

PDO (Process Data Objects) messages contain up to 8 bytes of process data. Using communication objects (communication/mapping parameters) the process data objects are mapped to Rx/Tx-PDOs. The frequency inverters support three RxPDOs (PLC → frequency inverter) and three TxPDOs (frequency inverter → PLC).

**Process data objects are linked directly to the functions of the frequency inverter.**

**PDO message:**

Byte	0	1	2	3	4	5	6	7
	Data	Data	Data	Data	Data	Data	Data	Data

The number of bytes is 1 ... 8 and depends on the mapped objects. The bytes are arranged in the Intel format.

Byte	0	1	2	3	4	5
	16 bit object		32 bit object			
	LSB	MSB	LSB	...	...	MSB

## 11.5 Emergency function (error message)

If there is a communication error or an error in the frequency inverter, the frequency inverter will send an error message. The error message contains the relevant error information. Once the error is acknowledged (error reset), an error message is sent, with the data bytes reset to zero.

Byte	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Contents	EEC	EEC	ER				MEC	MEC

EEC: Emergency Error Code as per DS301 ER: Emergency Register Code as per DS301 MEC: Manufacturer Error Code

The Manufacturer Error Code corresponds to the inverter Fault codes that are described in the Operating Instructions and in this documentation in chapter 15.5 "Error messages".

## 11.6 Synchronization (Distributed Clocks)

CM-EtherCAT® modules support synchronized communication via Distributed Clocks (DCs) and non-synchronized communication.

The configuration of the DCs is done via the PLC configuration utility. No settings have to be made on the frequency purchase side.

## 11.7 NMT functions

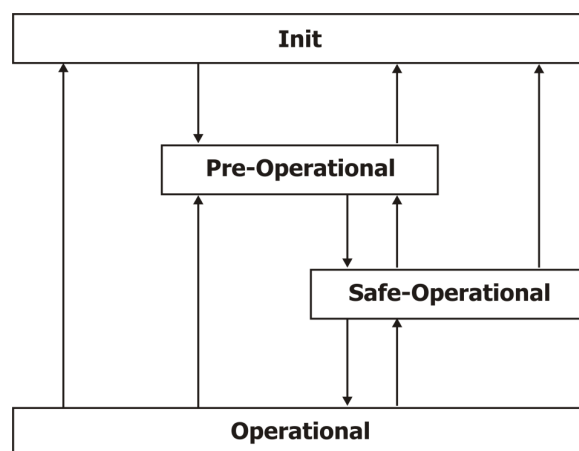
The NMT (= Network Management) functions describe the NMT Statemachine and NMT error saving functions.

The NMT status is displayed via the actual value parameter *NMTNode-State* **1443**.

### 11.7.1 NMT Statemachine

Upon startup, all EtherCAT® slaves run through the NMT Statemachine.

Possible NMT state changes:



NMT-Status	Description
Init	Initialising <ul style="list-style-type: none"> <li>No SDO Communication</li> <li>No PDO Communication</li> </ul>
Pre-Operational	Fieldbus active <ul style="list-style-type: none"> <li>SDO Communication</li> <li>No PDO Communication</li> </ul>
Safe-Operational	Fieldbus active <ul style="list-style-type: none"> <li>SDO Communication</li> <li>PDO Communication <ul style="list-style-type: none"> <li>IN data (TxPDO's) from inverter application send to PLC/master</li> <li>OUT data (RxPDO's) blocked (not transferred to application in inverter)</li> </ul> </li> </ul>
Operational	Fieldbus active <ul style="list-style-type: none"> <li>SDO Communication</li> <li>Full PDO Communication "OUT" and "IN" (RxPDO's, TxPDO's)</li> </ul>

## 11.8 OS Synchronization

The operating system (OS) of the frequency inverter can be synchronized with a PLC or other device. Synchronization of the operating system will improve the operating characteristics of the machine. Synchronization is used to eliminate CPU **phase** shifting between master and slave devices to make sure that calculations are carried out at the same time. Note, that only small deviations of the CPU clock frequencies between devices (i.e. different CPU Quartz cock frequencies) of  $\pm 1 \text{ ‰}$  can be compensated. The synchronization time must be a natural number (multiple of 1 ms).

OS_SyncSource 1452	
Operation mode	Function
0 - Auto	The synchronization source is selected automatically by the frequency inverter. <b>Factory setting.</b>
1 - CANopen®	The operating system is synchronized via CANopen®.
2 - System Bus	The operating system is synchronized via System Bus.

<i>OS_SyncSource</i> <b>1452</b>		
3 -	Ind. Ethernet Module	The operating system is synchronized via Ethernet Module.
4 -	Synchronised Ind. Ethernet Module	The operating system is synchronized via a synchronized Ethernet Module (e.g. EtherCAT®).
99 -	Off	The operating system is not synchronized.

**Auto** mode: Selection is done based on the decision table:

EtherCAT® active	System Bus active	Synchronization
yes	yes	Synchronization via EtherCAT®
yes	no	
no	yes	Synchronization via System Bus
no	no	No synchronization activated

**1453** *OS\_SyncSource\_Act* shows the active synchronization source.

Parameter **1451** *OS\_SyncTime* can be used to change the point of synchronization in a range of 1 ms. If unusual motor noise occurs, changing the *OS\_SyncTime* may improve the operating behavior.

Parameters		Settings		
No.	Description	Min.	Max.	Factory setting
1451	OS_SyncTime	700 us	900 us	800 us

For the VPlus Scope functions, the following sources are available for diagnosis:

Operation mode		Function
731 -	B: Sync. OS <-> Sysbus Ok	1 = Synchronization OS with System Bus OK, 0 = Synchronization OS with System Bus not OK,
852 -	SysBus SYNC time [us]	Sets the synchronization time cycles. Should show the set SYNC time or TxPDO time of the sending master.
853 -	SysBus SYNC position 1ms Task [us]	Represents the synchronization time in a range of 1 ms. Should be constant with minimum deviations.
854 -	B: Sync. OS <-> CANopen/EtherCAT Ok	1 = Synchronization OS with CANopen/EtherCAT® OK, 0 = Synchronization OS with CANopen/EtherCAT® not OK
856 -	EtherCAT SYNC time [us]	Sets the synchronization time cycles.
857 -	EtherCAT SYNC position 1ms Task [us]	Represents the synchronization time in a range of 1 ms. Should be constant with minimum deviations.
848 -	CANopen SYNC time [us]	Sets the synchronization time cycles.
849 -	CANopen SYNC position 1ms Task [us]	Represents the synchronization time in a range of 1 ms. Should be constant with minimum deviations.

## 11.9 Error Reset

Depending on the settings and the operating status of the device a fault reset can be done like described:

- When using control via parameter *Local/Remote* **412** = Statemachine:
- Set bit 7 in 0x6040 Control word = 0x0080.
- Via the Stop key of the operator panel
- A reset via the STOP key can only be executed, if Parameter *Local/Remote* **412** allows the control via keypad
- via parameter *Error Acknowledgement* **103** which is assigned a logic signal or a digital input
- A reset via a digital input can only be executed, if Parameter *Local/Remote* **412** allows that control or if a physical input with the suffix (Hardware) is selected.



Some errors will occur again after a fault reset. In such cases, it may be necessary to take certain measures (e.g. moving from a limit switch in the non-disabled direction).

## 12 Objects

The available objects are marked with Index and Subindex and must be addressed via this ID. In EtherCAT®, you can use CANopen® objects via CoE (CANopen® over EtherCAT®). The list in the CANopen® manual, at some places, contains additional objects which are required for operation with CANopen® as Field Bus system. These objects are not described in this document.

### 12.1 Lists of objects

The objects are listed in the following tables. The following definitions apply:

Type of access			
Read only	The PLC can only read data from the frequency inverter.		
Read/Write	The PLC is granted unlimited access (reading and writing) to the frequency inverter data.		
Data type			
Unsigned32	32-bit value:	0...2 <sup>32</sup> -1 0...0xFFFF FFFF	
Unsigned16	16-bit value:	0...2 <sup>16</sup> -1 0...0x FFFF	(0...65535)
Unsigned8	8-bit value:	0...2 <sup>8</sup> -1 0...0xFF	(0...255)
Integer32	Signed 32-bit value:	-2 <sup>31</sup> ...2 <sup>31</sup> -1 0x8000 0000...0x7FFF FFFF	
Integer16	Signed 16-bit value: -	2 <sup>15</sup> ...2 <sup>15</sup> -1 0x8000...0x7FFF	(-32768...32767)
Integer8	Signed 8-bit value: -	2 <sup>7</sup> ...2 <sup>7</sup> -1 0x80...0x7F	(-128...127)
PDO Mapping			
no	This object cannot be used for exchange of PDO. Only SDO can be used.		
Tx	This object can be transmitted from the frequency inverter in a TxPDO.		
Rx	This object can be transmitted to the frequency inverter in a RxPDO.		



"Highest sub index supported" shows the highest subindex supported by the object.

#### 12.1.1 Communication objects

Index	SubIndex	Name	SDO access	Data type	PDO mapping
<a href="#">0x1000</a>	0	Device type	Read Only	Unsigned32	no
<a href="#">0x1001</a>	0	Error register	Read Only	Unsigned8	no
<a href="#">0x1008</a>	0	Manufacturer device name	Read Only	Visible string	no
<a href="#">0x1009</a>	0	Manufacturer hardware version	Read Only	Visible string	no
<a href="#">0x100A</a>	0	Manufacturer software version	Read Only	Visible string	no
<a href="#">0x1010</a>	Store parameters				
	0	Highest sub index supported	Read Only	Unsigned8	no
	1	Save all parameters	Read/Write	Unsigned32	no
	2	Save communication parameters	Read/Write	Unsigned32	no
	3	Save application parameters	Read/Write	Unsigned32	no
<a href="#">0x1011</a>	Restore default parameters				
	0	Highest sub index supported	Read Only	Unsigned8	no
	1	Restore all default parameters	Read/Write	Unsigned32	no
	2	Restore communication default parameters	Read/Write	Unsigned32	no
	3	Restore application default parameters	Read/Write	Unsigned32	no

Index	SubIndex	Name	SDO access	Data type	PDO mapping
<a href="#">0x1018</a>	Identity object				
	0	Highest sub index supported	Read Only	Unsigned8	no
	1	Vendor ID	Read Only	Unsigned32	no
	2	Product code	Read Only	Unsigned32	no
	3	Revision number	Read Only	Unsigned32	no
	4	Serial number	Read Only	Unsigned32	no
<a href="#">0x1600</a>	RxPDO1 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no
<a href="#">0x1601</a>	RxPDO2 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no
<a href="#">0x1602</a>	RxPDO2 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no
<a href="#">0x1A00</a>	TxPDO1 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no

Index	SubIndex	Name	SDO access	Data type	PDO mapping
<a href="#">0x1A01</a>	TxPDO2 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no
<a href="#">0x1A02</a>	TxPDO3 mapping parameter				
	0	No. of mapped objects	Read/Write	Unsigned8	no
	1	1. mapped obj.	Read/write	Unsigned32	no
	2	2. mapped obj.	Read/write	Unsigned32	no
	3	3. mapped obj.	Read/write	Unsigned32	no
	4	4. mapped obj.	Read/write	Unsigned32	no
	5	5. mapped obj.	Read/write	Unsigned32	no
	6	6. mapped obj.	Read/write	Unsigned32	no
	7	7. mapped obj.	Read/write	Unsigned32	no
	8	8. mapped obj.	Read/write	Unsigned32	no

### 12.1.2 Manufacturer objects

Index	SubIndex	Name	SDO access	Data type	PDO mapping
<a href="#">0x2nnn</a>	0, 1, ... 9	Manufacturer-specific, Direct access to frequency inverter parameters, Read/write access for SDO transmission only			
<a href="#">0x3001</a>	0	Digital In actual values	Read only	Unsigned16	Tx
<a href="#">0x3002</a>	0	Digital Out actual values	Read only	Unsigned16	Tx
<a href="#">0x3003</a>	0	Digital Out set values	Read/write	Unsigned16	Rx
<a href="#">0x3004</a>	0	Boolean Mux	Read only	Unsigned16	Tx
<a href="#">0x3005</a>	0	Boolean Demux	Read/write	Unsigned16	Rx
<a href="#">0x3006</a>	0	Percentage set value	Read/write	Unsigned16	Rx
<a href="#">0x3007</a>	0	Percentage actual value	Read only	Unsigned16	Tx

### 12.1.3 Device profile objects

Index	Sub-Index	Name	SDO access	Data type	PDO mapping	Factory setting	Min...Max	Rel. param.
<a href="#">0x6007</a>	0	Abort connection option code	Read/write	Integer16	No	1	-2...3	p.388
<a href="#">0x603F</a>	0	Error code	Read only	Unsigned16	No	-	-	-
<a href="#">0x6040</a>	0	Controlword	Read/write	Unsigned16	Rx	-	-	p.410
<a href="#">0x6041</a>	0	Statusword	Read/only	Unsigned16	Tx	-	-	p.411
<a href="#">0x6042</a>	0	v/Target velocity	Read/write	Integer16	Rx	0	-32768...32767	-
<a href="#">0x6043</a>	0	v/velocity demand	Read only	Integer16	Tx	-	-	-
<a href="#">0x6044</a>	0	v/velocity actual value	Read only	Integer16	Tx	-	-	-
<a href="#">0x6046</a> v/velocity min max amount								
	0	Highest sub-index supported	Read only	Unsigned8	No	-	-	-
	1	v/velocity min amount	Read/write	Unsigned32	No	0	0...32767	p.418
	2	v/velocity max amount	Read/write	Unsigned32	No	32767	0...32767	p.419
<a href="#">0x6048</a> v/Velocity acceleration								
	0	Highest sub-index supported	Read only	Unsigned8	No			
	1	Delta speed	Read/write	Unsigned32	No	150	1...32767	p.420
	2	Delta time	Read/write	Unsigned16	No	1	1...65535	p.422
<a href="#">0x6049</a> v/Velocity deceleration								
	0	Highest sub-index supported	Read only	Unsigned8	No	-	-	-
	1	Delta speed	Read/write	Unsigned32	No	150	1...32767	p.421
	2	Delta time	Read/write	Unsigned16	No	1	1...65535	p.423
<a href="#">0x604A</a> v/velocity quick stop								
	0	Highest sub-index supported	Read only	Unsigned8	No	-	-	-
	1	Delta speed	Read/write	Unsigned32	No	150	1...32767	p.421
	2	Delta time	Read/write	Unsigned16	No	1	1...65535	p.423
<a href="#">0x6060</a>	0	Modes of operation	Write only	Integer8	Rx	2	2	-
<a href="#">0x6061</a>	0	Modes of operation display	Read only	Integer8	Tx	2	-	-
<a href="#">0x6071</a>	0	Target torque	Read/write	Integer16	Rx			-
<a href="#">0x6077</a>	0	Torque actual value	Read only	Integer16	Tx			p.224
<a href="#">0x6078</a>	0	Current actual value	Read only	Integer16	Tx			p.214
<a href="#">0x6079</a>	0	DC link voltage	Read only	Integer32	Tx			p.222
0x6502	0	Supported drive modes	Read only	Unsigned32	No	0x0202	0x0202	-





The representations of CANopen® objects and parameters may be different (refer to relevant object description).

## NOTE

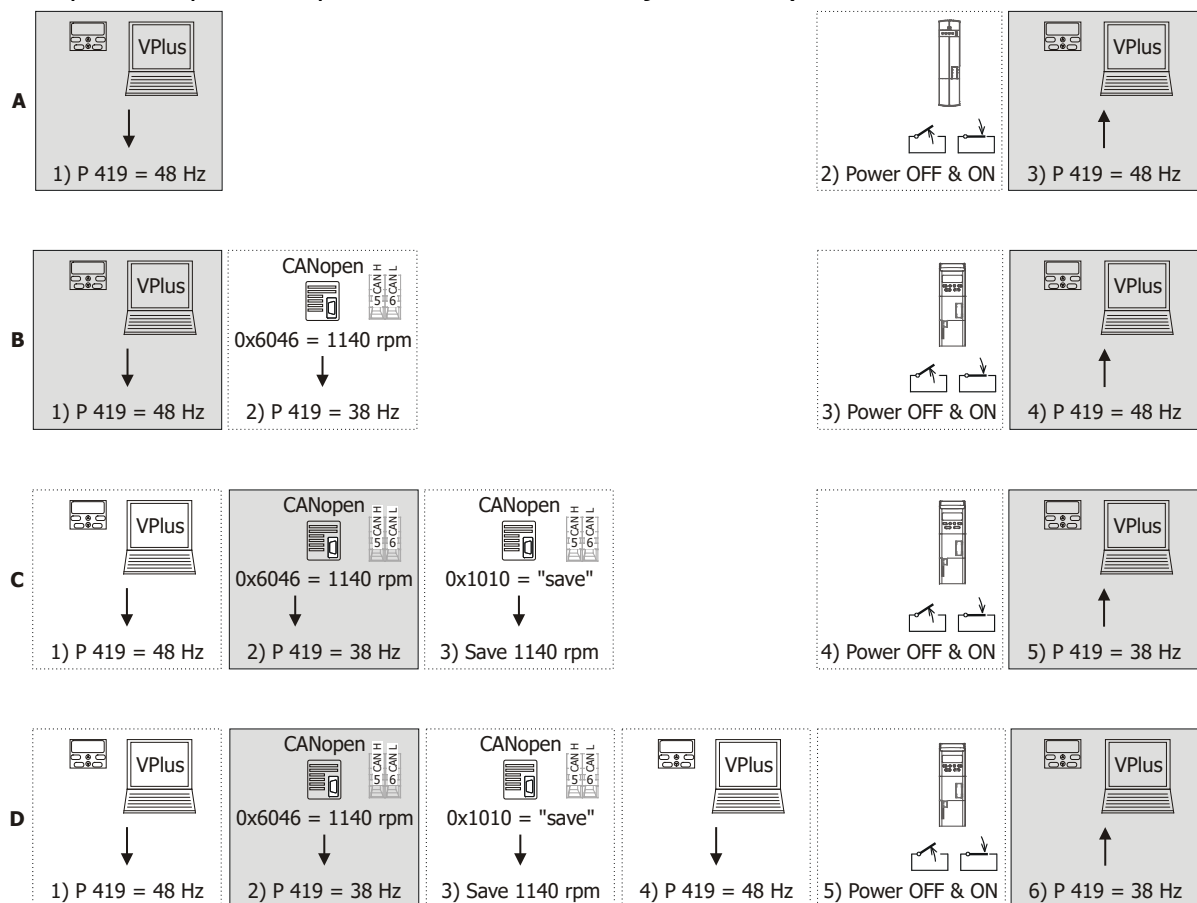
Some of the CANopen® DS402 objects listed above have corresponding frequency inverter parameters.

These objects are handled separately. If one of these CANopen® DS402 objects of SDO, followed by a Save instruction (see object [0x1010](#)) is written, the value is written in the non-volatile memory. Once the frequency inverter is turned on, these CANopen® DS402 objects will be saved again, and their values will overwrite the frequency inverter parameters.

The method must be used carefully. When a CANopen® DS402 object has been written and saved and, after that, the relevant parameter was set, e.g. via VPlus or the control panel, this parameter value will be overwritten by the value saved via the Save instruction when the inverter is turned again.

## Effect of Save command (object [0x1010](#))

(Example of sequence of parameter entries and object entries)



Sequence

**A**

Value of a parameter is set via the Operator Panel or VPlus. No "Save" command.

- 1) Setting of *Maximum Frequency* **419** = 48 Hz on Operator Panel or in VPlus.
- 2) Power OFF and ON.
- 3) The value of the Operator Panel/VPlus is active (48 Hz).

**B**

No "Save" command. The value of the CANopen® object is overwritten.

- 1) Setting of *Maximum Frequency* **419** = 48 Hz on Operator Panel or in VPlus.
- 2) Setting of CANopen® object **0x6046** = 1140 rpm\* (equivalent to 38 Hz).
- 3) Power OFF and ON.
- 4) The value of the CANopen® object is overwritten with the parameter value of the Operator Panel or VPlus. The value of the Operator Panel or from VPlus is active (48 Hz).

**C**

"Save" command. The value of the CANopen® object is stored.

- 1) Setting of *Maximum Frequency* **419** = 48 Hz on Operator Panel or in VPlus.
- 2) Setting of CANopen® object **0x6046** = 1140 rpm\* (equivalent to 38 Hz).
- 3) "Save" command via CANopen® object **0x1010**.
- 4) Power OFF and ON.
- 5) The value of CANopen® object **0x6046** is active (38 Hz).

**D**

"Save" command. The value of the CANopen® object is stored – even if the corresponding parameter value has been changed after the "Save" command.

- 1) Setting of *Maximum Frequency* **419** = 48 Hz on Operator Panel or in VPlus.
- 2) Setting of CANopen® object **0x6046** = 1140 rpm\* (equivalent to 38 Hz).
- 3) "Save" command via CANopen® object **0x1010**.
- 4) Setting of *Maximum Frequency* **419** = 48 Hz on Operator Panel or in VPlus.
- 5) Power OFF and ON.
- 6) The parameter value is overwritten with the value of the CANopen® object **0x6046**.  
The value of the CANopen® object **0x6046** is active (38 Hz).

Internal conversion to a frequency value taking into account the *No. of Pole Pairs* **373**. In this example the number of pole pairs is two (four-pole machine).

**NOTE**

For some frequency parameters which are calculated from CANopen® DS402 objects it is necessary to enter the number of pole pairs, e.g. for calculation of the deceleration or acceleration parameters. These calculations use the number of pole pairs from Dataset 1. If the number of pole pairs in the datasets is different, the result of the calculation may be implausible to the user. For this reason, we recommend writing the frequency inverter parameters via the SDO channel with objects **0x2nnn** (manufacturer) and not using the CANopen® DS402 objects. In this way, inconsistencies are avoided.

CANopen® DS402 objects with corresponding frequency inverter parameters are indicated in this manual.

## 12.2 Communication objects (0x1nnn)

Communication objects 0x1nnn contain all parameters for communication.



For easier usage, the objects are summarized by a table in each paragraph. This table is marked additional by colour.

Orange	= Read Only object
Green	= Read and Write object
Blue	= Write only object

### Abbreviations used

Access:	Access type:
r/w	Lesen/Schreiben (Read/Write)
ro:	Nur Lesen (Read only)
wo:	Nur Schreiben (Write only)
Map:	Mapping
Def.-Val:	Voreingestellter Wert (Default)

The Examples show some typical data telegrams, which could be observed or used with a CAN analyzing tool. The order displayed in the examples is the standard CANopen<sup>®</sup> format, lowest byte left, highest byte right.



The headings are displayed in the format *Index/Subindex Object name*.

### 12.2.1 0x1000/0 Device type

Index	Subindex	Meaning	Data type	Access	Map	Def. f.-Val:
0x1000	0	Device Type	Unsigned 32	ro	No	0

The device identification is carried out upon network startup. The information about the device type and functionality (type) is defined by the CANopen<sup>®</sup> DS402 standard.

Object 0x1000/0			
Additional Information		Device Profile Number	
Mode Bits	Type		
31	24	23	15
		16	0

The standard device profile "Drives and Motion Control" used by the frequency inverter is shown as device profile number 402. The other information specifies the device functionality of the frequency inverter.

Device Profile Number	= 402	drives and motion control
Type	= 1	frequency converter
Type	= 2	servo drive
Mode bits	= 0	unused

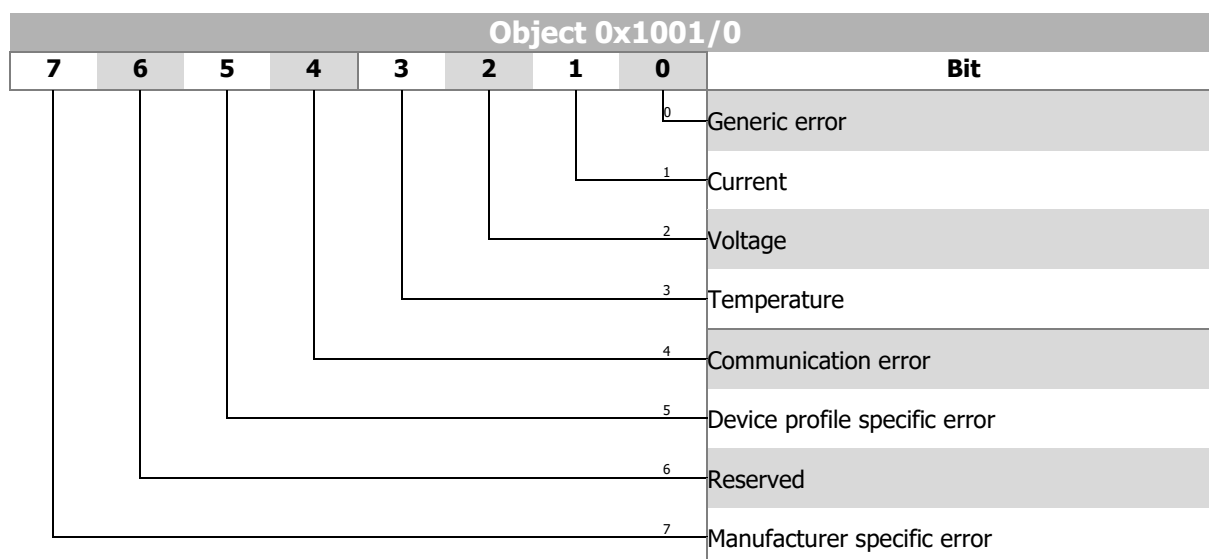
### 12.2.2 0x1001/0 Error Register

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1001	0	Error Register	Unsigned 8	ro	No	0

Object 0x1001/0 is the error register for internal frequency inverter errors. Status "no error" (0x1001/0 = 0) or "Error" (0x1001/0 ≠ 0) is displayed.

Detailed information on the device error can be read via VPlus, Parameter *Current error* **259** and EtherCAT® via Parameter **260** (see Chapter 15.5 "Error messages").

In case of an error, the PLC can evaluate detailed information via the Emergency Message (see Chapter 11.5 "Emergency function (error message)" and 12.5.2 "0x603F/0 Error code").



### 12.2.3 0x1008/0 Manufacturer Device Name

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1008	0	Manufacturer Device name	Visible string	ro	No	See Text

The device name is specified as a series of ASCII characters.

**Example: "AGILE"**

### 12.2.4 0x1009/0 Manufacturer Hardware Version

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1009	0	Manufacturer hardware version	Visible string	ro	No	See Text

The device name is displayed as a sequence of ASCII characters.

**Example: "AGL 400 512 344"**

### 12.2.5 0x100A/0 Manufacturer Software Version

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x100A	0	Manufacturer Software version	Visible string	ro	No	See Text

The software version is displayed as a series of ASCII characters.

**Example: "6.1.2"**

## 12.2.6 0x1010/n Store Parameters

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1010	0	Highest sub-index supported	Unsigned8	ro	No	3
	1	Store all parameters	Unsigned32	r/w	No	See text
	2	Store communication parameters	Unsigned32	r/w	No	See text
	3	Store application parameters	Unsigned32	r/w	No	See text

With object 0x1010/n parameter/object settings can be stored to non-volatile memory. This object supports three subindexes with various functions.

Writing of "save" in 0x1010/3 saves all application parameters ([0x6nnn](#)) in the non-volatile memory.

### Specification for writing the "save" instruction

LSB			MSB
"s"	"a"	"v"	"e"
0x73	0x61	0x76	0x65



Writing of values other than "save" will result in cancellation of SDO. The store command is **not** processed.

## 12.2.7 0x1011/n Restore default Parameters

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1011	0	Highest sub-index supported	Unsigned8	ro	No	3
	1	Restore all parameters.	Unsigned32	r/w	No	See text
	2	Restore communication parameters.	Unsigned32	r/w	No	See text
	3	Restore application parameters.	Unsigned32	r/w	No	See text

With object 0x1011/n, you can reset parameters/objects to the default values. This object supports three subindexes with different functions.

Writing of "load" in 0x1011/3 restores all application parameters ([0x6nnn](#)).

### Specification for writing the "load" instruction

LSB			MSB
"l"	"o"	"a"	"d"
0x6C	0x6F	0x61	0x64



Writing of values other than "load" will result in cancellation of SDO. The restore defaults command is **not** processed.

### 12.2.8 0x1018/n Identity Object (device manufacturer and device)

The object *identity* provides information about the device manufacturer and the device.

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1018	0	Highest sub index supported	Unsigned8	ro	No	4
	1	Vendor ID	Unsigned32	ro	No	See text
	2	Product code (type ID)	Unsigned32	ro	No	See text
	3	Revision number	Unsigned32	ro	No	See text
	4	Serial number	Unsigned32	ro	No	See text

"Vendor ID" "0xD5" refers to manufacturer **Bonfiglioli Vectron GmbH**.

This "Vendor ID" is assigned by the CANopen® user organization "CAN in Automation" (CiA) in Erlangen ([www.can-cia.org](http://www.can-cia.org)) and EtherCAT® (EtherCAT Technology Group) in Nuremberg.

#### Product code:

shows the type ID of the frequency inverter.

#### Revision number:

shows the revision level of the EtherCAT®/CANopen® system of the frequency inverter.

#### Serial number:

shows the serial number of the frequency inverter.

### 12.2.9 0x1600/n, 0x1601/n, 0x1602/n, RxPDO Mapping Parameter

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1600	0	Number of mapped objects	Unsigned8	rw	No	2
0x1601						
0x1602						
	1	1 <sup>st</sup> mapped obj.	Unsigned32	rw	No	See text
	2	2 <sup>nd</sup> mapped obj.	Unsigned8	rw	No	See text
	3	3 <sup>rd</sup> mapped obj.	Unsigned8	rw	No	See text
	4	4 <sup>th</sup> mapped obj.	Unsigned8	rw	No	See text
	5	5 <sup>th</sup> mapped obj.	Unsigned8	rw	No	See text
	6	6 <sup>th</sup> mapped obj.	Unsigned8	rw	No	See text
	7	7 <sup>th</sup> mapped obj.	Unsigned8	rw	No	See text
	8	8 <sup>th</sup> mapped obj.	Unsigned8	rw	No	See text

#### RxPDO-Mapping-Parameter:

0x1600/n RxPDO1

0x1601/n RxPDO2

0x1602/n RxPDO3

0x1600/0 = 0 = no object mapped

0x1600/0 = 1 ... 8 = 1 ... 8 mapped objects

#### Mapping entry:

MSB			LSB
Object index		Subindex	Length (No. of bits)
High byte	Low byte	si	ll

#### Examples:

Mapping of [0x6040/0 controlword](#) (unsigned16 = 10<sub>hex</sub>) to "1<sup>st</sup> mapped obj." in RxPDO1:

0x1600/1 = [0x60400010](#)

Objects and their data types are listed in chapter 12.1.

## Default mapping

RxPDO1	0x1600/0	0x1600/1	0x1600/2	0x1600/3...8
	2	<a href="#">0x6040</a> Controlword	<a href="#">0x6042</a> vI Target velocity	0x00000000
RxPDO2	0x1601/0			
	0	No mapping		
RxPDO3	0x1602/0			
	0	No mapping		

### 12.2.10 0x1A00/n, 0x1A01/n, 0x1A02/n, TxPDO mapping parameters

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x1A00 0x1A01 0x1A02	0	Number of mapped objects	Unsigned8	rw	No	2
	1	1 <sup>st</sup> mapped obj.	Unsigned32	rw	No	See text
	2	2 <sup>nd</sup> mapped obj.	Unsigned32	rw	No	See text
	3	3 <sup>rd</sup> mapped obj.	Unsigned32	rw	No	See text
	4	4 <sup>th</sup> mapped obj.	Unsigned32	rw	No	See text
	5	5 <sup>th</sup> mapped obj.	Unsigned32	rw	No	See text
	6	6 <sup>th</sup> mapped obj.	Unsigned32	rw	No	See text
	7	7 <sup>th</sup> mapped obj.	Unsigned32	rw	No	See text
	8	8 <sup>th</sup> mapped obj.	Unsigned32	rw	No	See text

### TxPDO-Mapping-Parameter

0x1A00/n TxPDO1

0x1A01/n TxPDO2

0x1A02/n TxPDO3

0x1A00/0 = 0 = no object mapped

0x1A00/0 = 1 ... 8 = 1 ... 8 mapped objects

MSB			LSB
Object index		Subindex	Length (No. of bits)
High byte	Low byte	si	ll

### Examples:

Mapping of [0x6041/0](#) *statusword* (unsigned16) to "1<sup>st</sup> mapped obj." in TxPDO1:

0x1A00/1 = [0x60410010](#)

### Default mapping

TxPDO1	0x1A00/0	0x1A00/1	0x1A00/2	0x1A00/3...8
	2	<a href="#">0x6041</a> statusword	<a href="#">0x6044</a> vI/velocity actual value	0x00000000
TxPDO2	0x1A01/0	0x1A01/1	0x1A01/2...8	
	0	No mapping		
TxPDO3	0x1A02/0	0x1A02/1	0x1A02/2...8	
	0	No mapping		



The number of objects that can be mapped depends on the length of the object.  
The maximum number of bytes that can be mapped is 8.

## 12.3 Manufacturer objects (0x2nnn) – Parameter access

For direct write/read access to frequency inverter parameters via the SDO channel, a parameter is addressed via index and subindex. The index and Subindex are used for access to frequency inverter parameter as follows:

**Index** = **Parameter number + 0x2000**  
**Subindex** = **Required dataset (0, 1 ... 4, 5, 6 ... 9)**



Mapping of numerical data is always an integer or long data type. Values with decimal places will be written without decimal point (e.g. value 17.35 will be transmitted as 1735).

### 12.3.1 Handling of datasets / cyclic writing of parameters

The parameter values are accessed based on the parameter number and the required dataset. There are parameters which only have one value (data set 0), as well as parameters which have four values (data sets 1...4). The latter are used for the data set change-over of a parameter.

If parameters with four data values are set via data set = 0, all four data sets are set to the same transmitted value. A read access with data set = 0 to such parameters is only successful if all four data sets are set to the same value. If this is not the case, an error will be signaled.

#### NOTE

The values are entered automatically in the EEPROM of the controller. However, only a limited number of write cycles is permissible for the EEPROM (approx. 1 million cycles). When this number is exceeded, the EEPROM will be destroyed.

In the RAM, the data is not protected against loss of power. Once power supply is disrupted, the data must be written again.

This mechanism is activated by the target data set being increased by five in the specification of the data set.

#### Writing on virtual dataset in RAM

Parameters	EEPROM	RAM
Dataset 0	0	5
Dataset 1	1	6
Dataset 2	2	7
Dataset 3	3	8
Dataset 4	4	9



### 12.3.2 Handling index parameters / cyclic writing

Index parameters are used for various frequency inverter functions. Here, 16 or 32 indexes are used instead of the 4 data sets. For each function, the individual indexes are addressed separately via an index access parameter. Via the indexing parameter, you can select if the data is to be written to EEPROM or RAM.

Function	Parameters	Index range		Index access parameter
		Write EEPROM and read	Write RAM	
PLC function (Function table)	<b>1343</b> <i>FT-instruction</i> <b>1344</b> <i>FT-input 1</i> <b>1345</b> <i>FT-input 2</i> <b>1346</b> <i>FT-input 3</i> <b>1347</b> <i>FT-input 4</i> <b>1348</b> <i>FT-Parameter 1</i> <b>1349</b> <i>FT-Parameter 2</i> <b>1350</b> <i>FT-target output 1</i> <b>1351</b> <i>FT- target output 2</i> <b>1352</b> <i>FT-commentary</i>	0 <sup>1)</sup> ; 1...32	33 <sup>1)</sup> ; 34...65	<b>1341</b> Write <b>1342</b> Read
Multiplexer	<b>1252</b> <i>Mux Input</i>	0 <sup>1)</sup> ; 1...16	17 <sup>1)</sup> ; 18...33	<b>1250</b> Write <b>1251</b> Read
CANopen® Multi-plexer	<b>1422</b> <i>CANopen Mux Input</i>	0 <sup>1)</sup> ; 1...16	17 <sup>1)</sup> ; 18...33	<b>1420</b> Write <b>1421</b> Read

1) When the indexing parameter = 0, all indexes will be written upon parameter access in EEPROM.  
17 or 33 will write all indexes in RAM.

#### NOTE

The values are entered automatically in the EEPROM of the controller. However, only a limited number of write cycles is permissible for the EEPROM (approx. 1 million cycles). When this number is exceeded, the EEPROM will be destroyed.

In the RAM, the data is not protected against loss of power. Once power supply is disrupted, the data must be written again.

This mechanism is activated by the target data set being increased by five in the specification of the data set.

#### 12.3.2.1 Example: Writing of index parameters

Typically, index parameters are written during commissioning.

Writing of Parameter **1344** *PLC Input 1* (Type int), in Index 34 in RAM (→ Index 34 for write access) with parameter value 2380.

Index = 1341 + 0x2000 = 0x253D, value (int) = 34 = 0x0022

Index = 1344 + 0x2000 = 0x2540, value (int) = 2380 = 0x094C



If various parameters in an index are to be edited, it will be sufficient to set index access via parameter **1341** once first.

### 12.3.2.2 Example: Reading of index parameters

In order to read an index parameter, you will have to set the index parameter to the relevant index first, then you can read the parameter.

Reading from Parameter **1344** *PLC Input 1* (type int), in Index 1 with parameter value 6.

Index = 1342 + 0x2000 = 0x253E, value (int) = 1 = 0x0001

Index = 1344 + 0x2000 = 0x2540, value (int) = 6 = 0x0006



If various parameter of an index are to be read, it will be sufficient to set index access via parameter **1342** once first.

## 12.4 Manufacturer objects (0x3000 ... 0x5FFF)

In addition to the device profile objects the following manufacturer specific objects are implemented.

### 12.4.1 0x3001/0 Digital In actual value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3001	0	Digital In actual value	Unsigned16	ro	Tx	

Object 0x3001 *Digital In actual value* shows – like parameter *Digital inputs* **250** – the current state of the digital inputs and multifunction input 1 (when parameter *Operation mode* **452** is set to “3 – Digital input”).

### 12.4.2 0x3002/0 Digital Out actual value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3002	0	Digital Out actual value	Unsigned16	ro	Tx	

Object 0x3002 *Digital Out actual value* shows – like parameter *Digital outputs* **254** – the current state of the digital outputs and multifunction output 1 (when parameter *Operation mode* **550** is set to “1 – Digital”). The selection of digital outputs depends on the extension modules installed as an option.

### 12.4.3 0x3003/0 Digital Out set values

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3003	0	Digital Out set values	Unsigned8	rw	Rx	0

Via object 0x3003, five digital parameter sources are available requiring assignment of digital sources.

Object 0x3003			
Bit	Source number	Source name	Operation mode Digital output
0	810	Obj 0x3003 Digout 1	90/190
1	811	Obj 0x3003 Digout 2	91/191
2	812	Obj 0x3003 Digout 3	92/192
3	813	Obj 0x3003 Digout 4	93/193
4	814	Obj 0x3003 Digout 5	94/194

The value range of object 0x3003 is limited from 0 to 31.

No.	Object	Min.	Max.
0x3003/0	Digital Out set values	0	31 (= 0x1F)

Digital outputs use these sources as operation modes 90 ... 94 *Obj 0x3003 DigOut 1 ... 5* and, inverted, as 190 ... 194 *inv. Obj 0x3003 DigOut 1 ... 5* (e.g. parameter *Op. Mode Digital Output 1 530*). These object bits can be mapped to the output as required

#### Example:

Function	Parameter no.	Choice list (excerpt)
Op. mode digital output 3	532	0 - OFF 1 - Ready or Standby signal 2 - Run signal ... 43 - External fan 90 - Obj 0x3003 Digout 1 91 - Obj 0x3003 Digout 2 92 - Obj 0x3003 Digout 3 93 - Obj 0x3003 Digout 4 94 - Obj 0x3003 Digout 5 ... 143 - inv. external fan 190 - inv. Obj 0x3003 Digout 1 191 - inv. Obj 0x3003 Digout 2 192 - inv. Obj 0x3003 Digout 3 193 - inv. Obj 0x3003 Digout 4 194 - inv. Obj 0x3003 Digout 5 ...

Sources 810...814 *Obj 0x3003 DigOut 1 ... 5* can be selected directly via the choice list for parameters. This can be used, for example, for direct setting of Boolean inputs.

#### 12.4.4 0x3004/0 Boolean Mux

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3004	0	Boolean Mux	Unsigned16	ro	Tx	

Via object 0x3004, up to 16 packed Boolean values can be read. Each bit in 16-bit object 0x3004 shows the actual value of the assigned Boolean source.

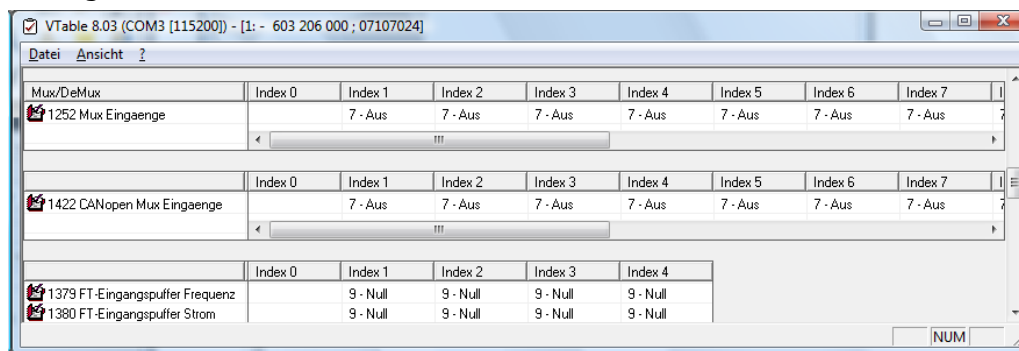


Bit numbers 0 ... 15 correspond to index numbers 1 ... 16!

The sources of the 16 bits can be selected from a choice list of index parameter *CANopen Mux Input* **1422**. Parameters **1420** and **1421** are write and read parameters which must be set before writing/reading of parameter **1422**.

By using VTable this process is easier and more clearly laid out.

For writing and reading of index parameters, please refer to 12.3.2 "Handling index parameters / cyclic writing".



Default value is 7 – Off.

#### 12.4.5 0x3004/0 Boolean DeMux

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3005	0	Boolean Demux	Unsigned16	rw	Rx	0

Via object 0x3005, up to 16 packed Boolean values can be written. These values are available as sources and can be selected via a choice list for parameters as objects **832...847** *Obj 0x3005 Demux Out 1...16*.

Object 3005		
Bit no.	Source no.	Source name
0	832	Obj. 0x3005 Demux Out 1
1	833	Obj. 0x3005 Demux Out 2
2	834	Obj. 0x3005 Demux Out 3
3	835	Obj. 0x3005 Demux Out 4
4	836	Obj. 0x3005 Demux Out 5
5	837	Obj. 0x3005 Demux Out 6
6	838	Obj. 0x3005 Demux Out 7
7	839	Obj. 0x3005 Demux Out 8
8	840	Obj. 0x3005 Demux Out 9
9	841	Obj. 0x3005 Demux Out 10
10	842	Obj. 0x3005 Demux Out 11
11	843	Obj. 0x3005 Demux Out 12
12	844	Obj. 0x3005 Demux Out 13
13	845	Obj. 0x3005 Demux Out 14
14	846	Obj. 0x3005 Demux Out 15
15	847	Obj. 0x3005 Demux Out 16

### 12.4.6 0x3006/0 Percentage set value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3006	0	Percentage set value	Unsigned16	rw	Rx	0

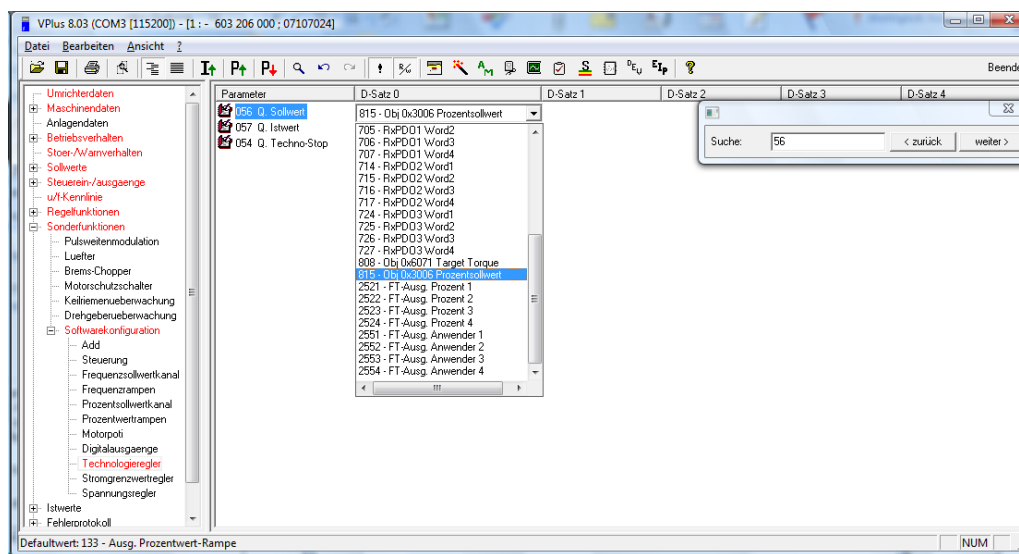
Via object 0x3006, you can write a percentage source – e.g. parameter *Q. reference* **056**.

The value of object 0x3006 is available as a source and can be selected as **815 – Obj 0x3006 Reference Percentage** via a choice list for parameters.

The value range of object 0x3006 is limited from -30000 to 30000 (equivalent to percentage range from - 300.00 % to 300.00 %)

No.	Object	Min.	Max.
0x3003/0	Percentage set value	-30000 (= 0x8AD0)	30000 (= 0x7530)

Example: Parameters of technology controller *Q. reference* **056**.



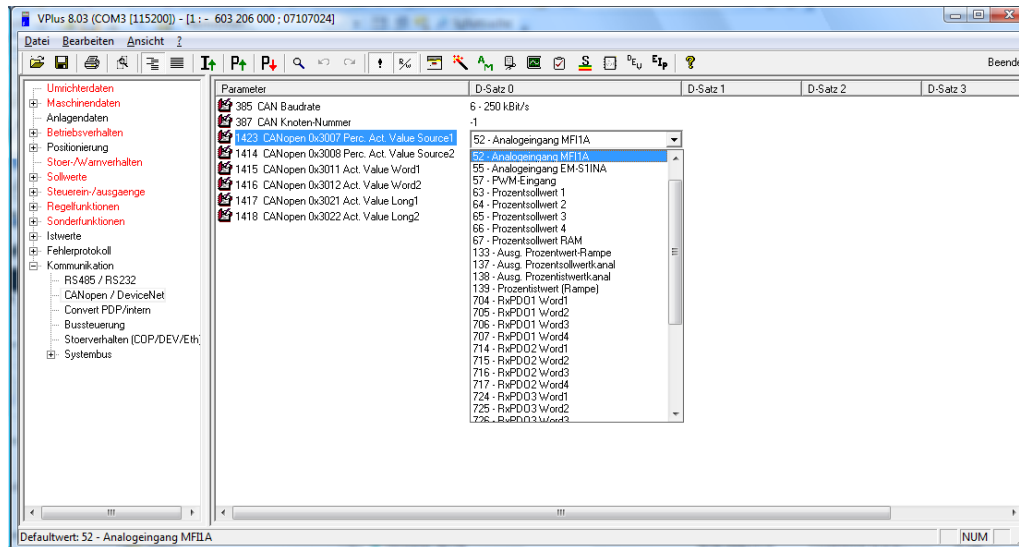
The percentage value is scaled as percent \* 100 (e.g. 5678 represents 56.78%).

### 12.4.7 0x3007/0 Percentage Actual Value Source 1

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3007	0	Percentage Actual Value Source 1	Unsigned16	ro	Tx	

Object 0x3007 shows the actual value of the percentage source which can be selected via parameter *CANopen Percentage Actual Value Source 1* **1423**.

Default setting: 52 – Analog input MF11A.



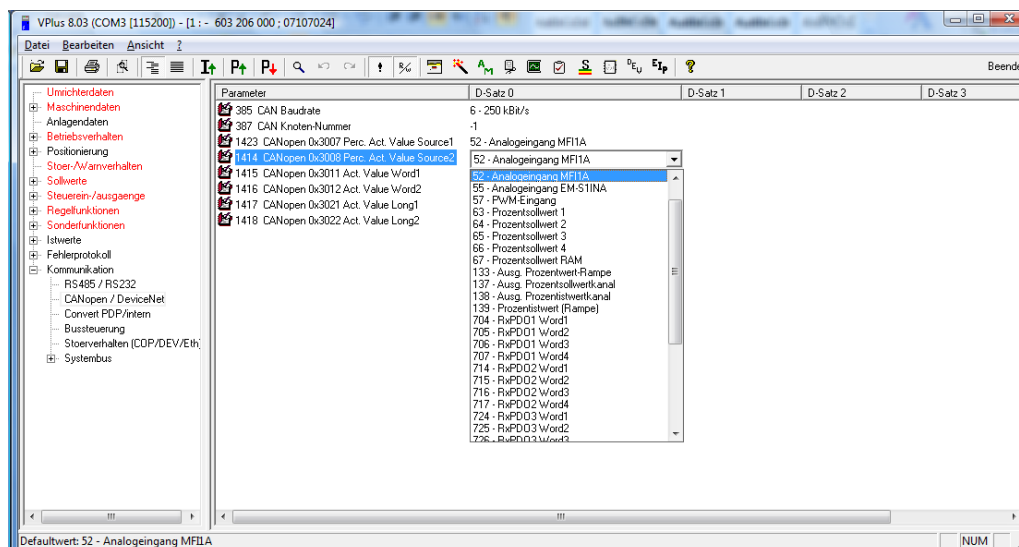
The percentage value is scaled as percent \* 100 (e.g. 5678 represents 56.78%).

### 12.4.8 0x3008/0 Percentage Actual Value Source 2

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3008	0	Percentage Actual Value Source 2	Unsigned16	ro	Tx	

Object 0x3008 shows the actual value of the percentage source which can be selected via parameter *CANopen Percentage Actual Value Source 2* **1414**.

Default setting: 52 – Analog input MF11A.



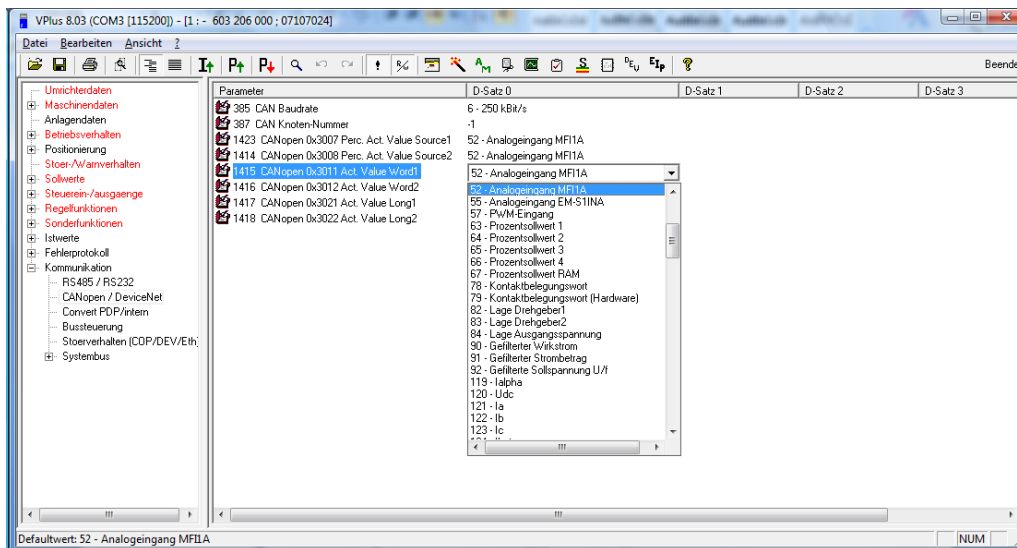
The percentage value is scaled as percent \* 100 (e.g. 5678 represents 56.78%).

### 12.4.9 0x3011/0 Actual Value Word 1

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3011	0	Actual Value Word 1	Unsigned16	ro	Tx	

Object 0x3011 shows the actual value of the word source which can be selected via parameter *CANopen 0x3011 Act. Value Word 1* **1415**.

Default setting: 52 – Analog input MFI1A.

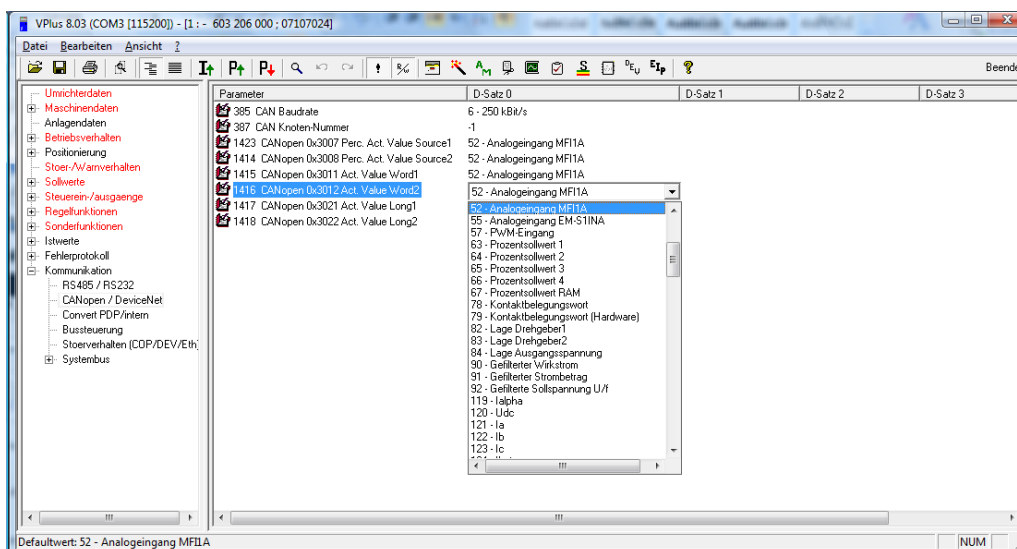


### 12.4.10 0x3012/0 Actual Value Word 2

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3012	0	Actual Value Word 2	Unsigned16	ro	Tx	

Object 0x3012 shows the actual value of the word source which can be selected via parameter *CANopen 0x3012 Act. Value Word 2* **1416**.

Default setting: 52 – Analog input MFI1A.

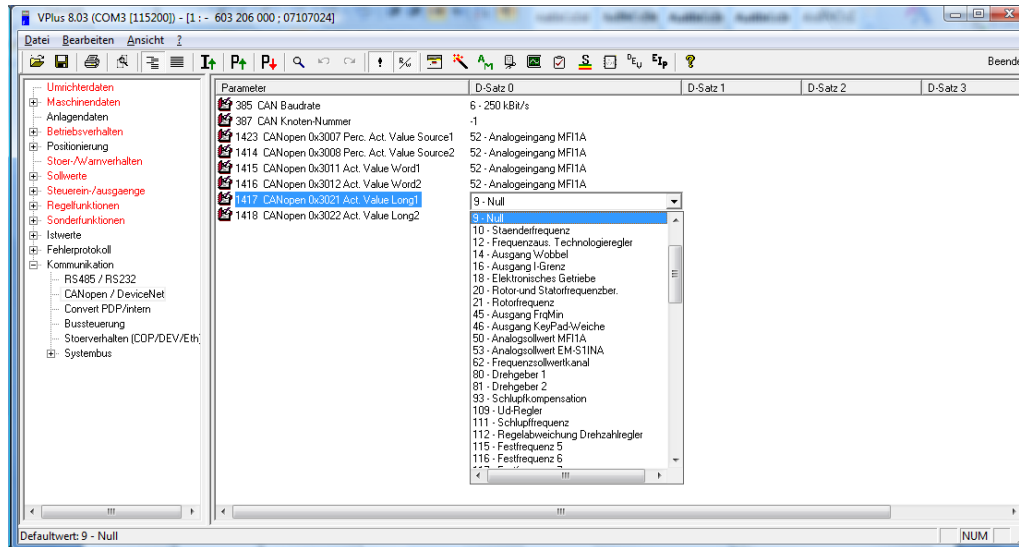


### 12.4.11 0x3021/0 Actual Value Long 1

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3021	0	Actual Value Long 1	Unsigned32	ro	Tx	

Object 0x3021 shows the actual value of the long source which can be selected via parameter *CANopen 0x3021 Act. Value Long 1* **1417**.

Default setting: 9-zero.

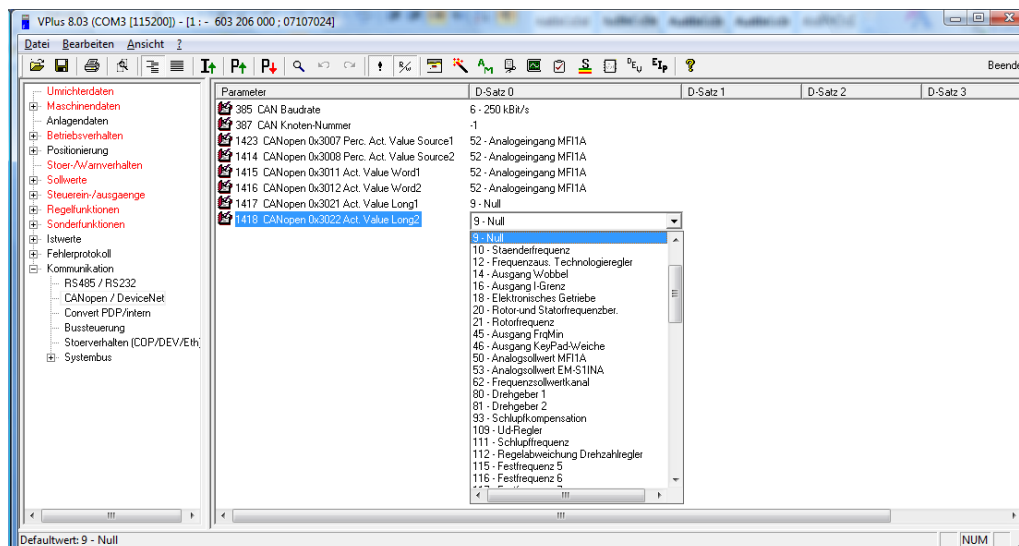


#### 12.4.12 0x3022/0 Actual Value Long 2

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3022	0	Actual Value Long 2	Unsigned32	ro	Tx	

Object 0x3022 shows the actual value of the long source which can be selected via parameter *CANopen 0x3022 Act. Value Long 2* **1418**.

Default setting: 9-zero.



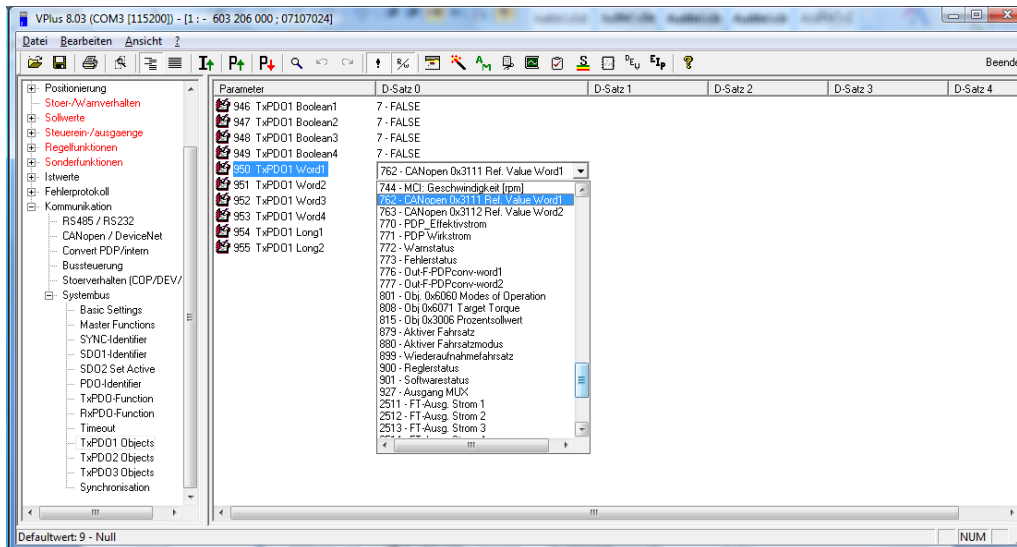
#### 12.4.13 0x3111/0 Ref. Value Word 1 (reference value word source 1)

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3111	0	Ref. Value Word 1	Unsigned16	rw	Rx	0

Via object 0x3111, you can write a word source – e.g. parameter *TxPDO1 Word 1* **950** of System Bus.

The value of object 0x3111 is available as a source and can be selected as 762 – *CANopen 0x3111 Ref. Value* via a choice list for parameters.



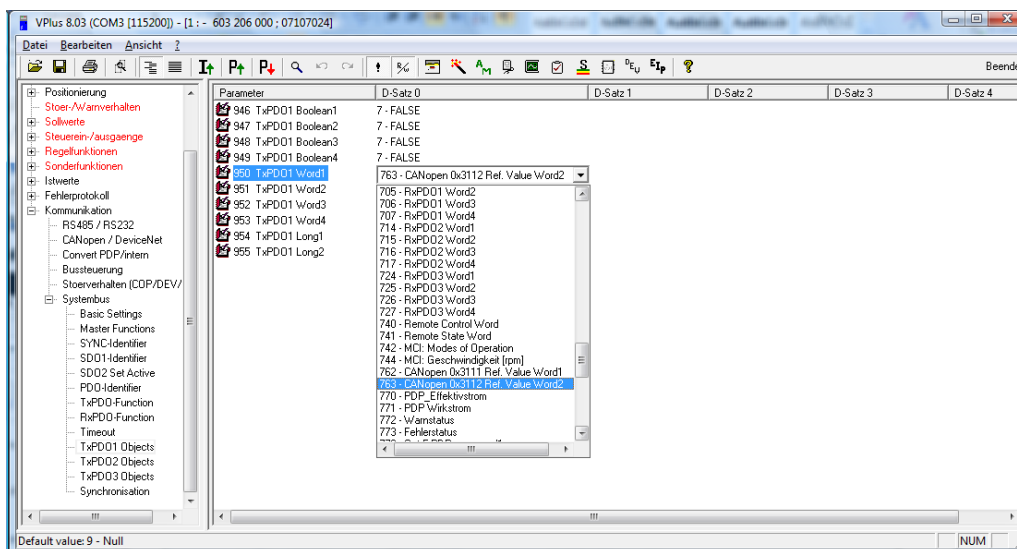


### 12.4.14 0x3112/0 Ref. Value Word 2

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3112	0	Ref. Value Word 2	Unsigned16	rw	Rx	0

Via object 0x3112, you can write a word source – e.g. parameter *TxPDO1 Word 1* **950** of System Bus.

The value of object 0x3112 is available as a source and can be selected as 763 – *CANopen 0x3112 Ref. Value* via a choice list for parameters.

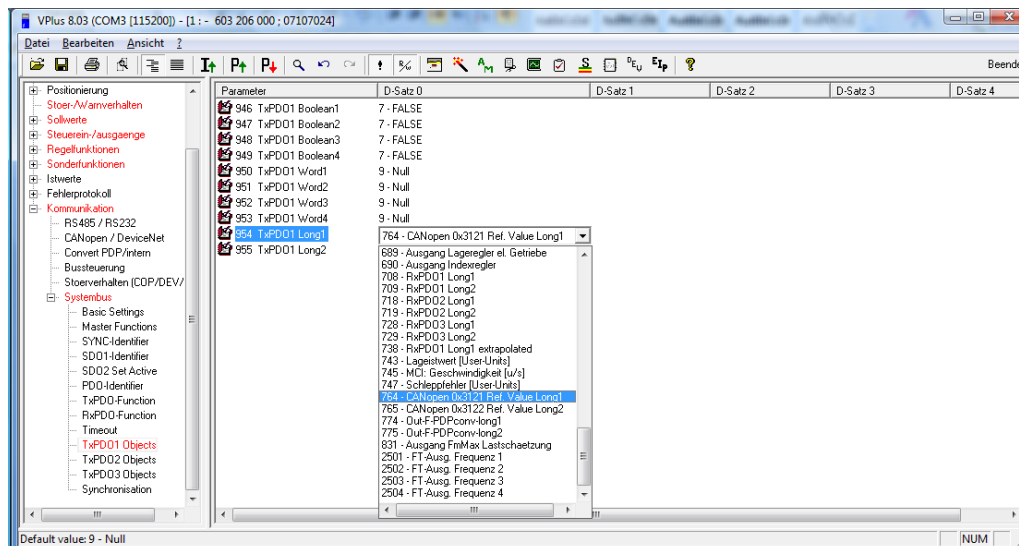


### 12.4.15 0x3121/0 Ref. Value Long 1

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3121	0	Ref. Value Long 1	Unsigned32	rw	Rx	0

Via object 0x3121, you can write a long source – e.g. parameter *TxPDO1 Long 1* **954** of System Bus.

The value of object 0x3121 is available as a source and can be selected as 764 – *CANopen 0x3121 Ref. Value* via a choice list for parameters.

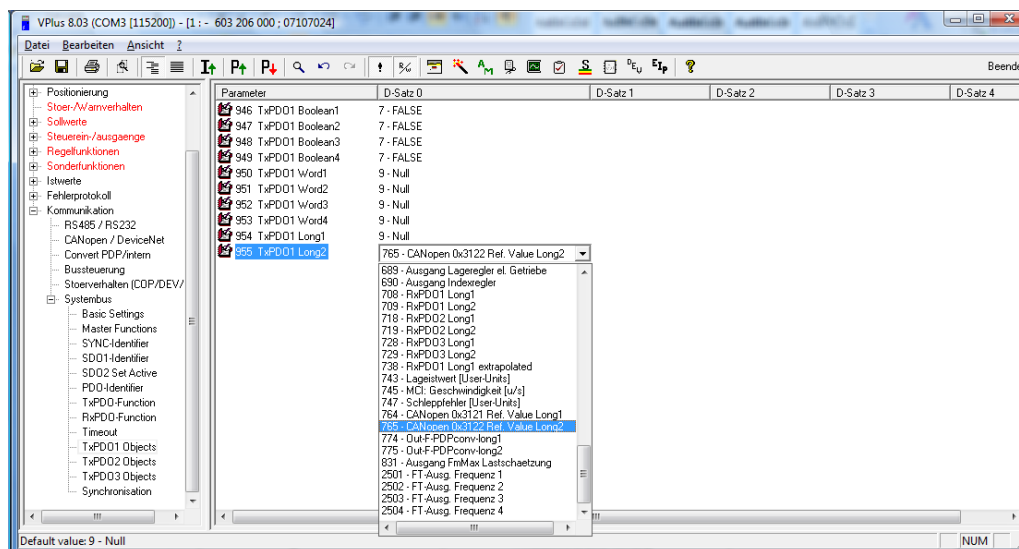


## 12.4.16 0x3122/0 Ref. Value Long 2 (reference value long source 2)

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x3122	0	Ref. Value Long 2	Unsigned32	rw	Rx	0

Via object 0x3122, you can write a long source – e.g. parameter *TxPDO1 Long 2* **955** of System Bus.

The value of object 0x3122 is available as a source and can be selected as 765 – *CANopen 0x3122 Ref. Value* via a choice list for parameters.



## 12.5 Device Profile Objects (0x6nnn)

### 12.5.1 0x6007/0 Abort Connection option code (behavior in case of error in bus connection)

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6007	0	Abort Connection option code	Integer16	rw	No	1

Object *abort connection option code* defines the operating characteristics of the frequency inverter in the case of an error in the bus connection due to BusOff, RxPDO length error or NMT state change (leaving of NMT state "Operational").

Object 0x6007/0		
Operation mode	Function in "Control via state machine"	Function in "Other control"
0 - No reaction	Operating point is maintained.	Operating point is maintained.
1 - Error ( <b>default setting</b> )	The controller (statemachine) switches to "Fault" state immediately.	The controller (statemachine) switches to "Fault" state immediately.
2 - Switch-off	The controller (statemachine) generates the "Disable voltage" command and switches to "Switch on disabled" .	
3 - Quick Stop	The controller (statemachine) generates the "Quick stop" command and switches to "Switch on disabled".	
-1 - Ramp stop + (Minus 1) Error	The controller (statemachine) generates the "Disable voltage" command and switches to "Fault" state once the drive has been stopped.	
-2 - Quick stop + (Minus 2) Error	The controller (statemachine) generates the "Quick stop" command and switches to "Fault" state once the drive has been stopped.	

## NOTE

Object *abort connection option code* corresponds to frequency inverter parameter *Bus Error Behaviour* **388**.

The parameter settings *Bus Error Behaviour* **388** = -2...3 are evaluated depending on parameter *Local/Remote* **412**.

No.	Object	Min.	Max.
0x6007/0	Abort Connection option code	-2 (=0xFFFE)	3

<i>Bus Error Behaviour</i> <b>388</b>	<b>0x6007</b>
0	0
1	1
2	2
3	3
4	-1
5	-2



Writing of parameters *Bus Error Behaviour* **388** and writing of object 0x6007 have the same effect.



When object 0x6007 was written and a parameter saving instruction (Object [0x1010](#)) was generated after that, the value of 0x6007 will be saved in the non-volatile memory. When the frequency inverter is switched on the next time, the value for 0x6007 set before will be activated again and overwrite the setting of Parameter *Bus Error Behaviour* **388**.

For details about possible faults, refer to Chapter 15.5 "Error messages".

## 12.5.2 0x603F/0 Error code

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x603F	0	Error code	Unsigned16	ro	No	

In object *error code*, the last error that has occurred will be saved.

According to CANopen® DS402, a great number of possible error messages is specified. The following list shows the relation between the error code displayed by the frequency inverter on the control panel and the error saved in object *error code*.

Error messages				
Device Error		CANopen® DS402 error code		Meaning
F00	xx	00	00	No error has occurred.
Overload				
F01	xx	23	10	Frequency inverter was overloaded
Heat sink				
F02	xx	42	10	Heat sink temperature outside of temperature limits
Interior				
F03	xx	41	10	Interior temperature outside of temperature limits
Motor connection				
F04	xx	43	10	Motor temperature too high or sensor defective
Output current				
F05	xx	23	40	Motor phase current above current limit
DC link voltage				
F07	xx	32	10	DC link voltage outside of voltage range
Electronic voltage				
F08	xx	51	11	Electronic voltage outside of voltage range
Motor connection				
F13	xx	23	30	Earth fault at frequency inverter output.
General error				
Fyy	xx	10	00	Other error messages

If CANopen® DS402 *error code* 1000 = generic-error occurs, the error code can be read via parameter *Current error* **260** (unsigned16). Parameter *Current error* **260** contains the error code in internal product-specific format.

For the error code assignment table of the relevant messages, refer to the operating instructions.

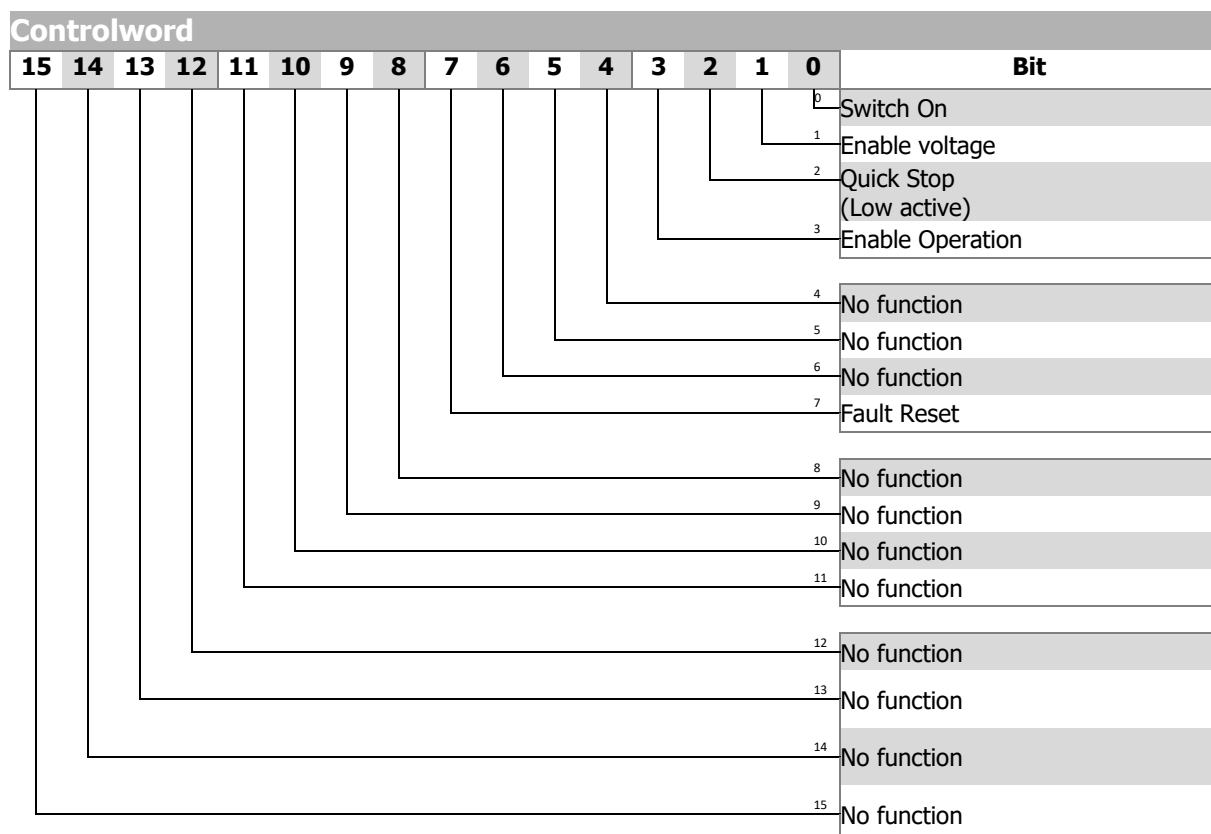
In the "Emergency Message", the error code of the frequency inverter is transmitted in bytes 4 ... 7, the CANopen® DS402 error code in bytes 0 and 1.

### 12.5.3 0x6040/0 Controlword

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6040	0	Controlword	Unsigned16	rw	Rx	0

Object 0x6040/0 *controlword* is relevant to the frequency inverter if parameter *Local/Remote* **412** is set to "1 - Control via statemachine".

Object 0x6040/0 *controlword* is linked to the internal parameter *Control word* **410**. Also refer to Chapters 13.2 "Control via state machine" and 13.1 "Control via contacts/remote contacts". When using CANopen® use object 0x6040/0 *controlword* instead of parameter *Control word* **410**.



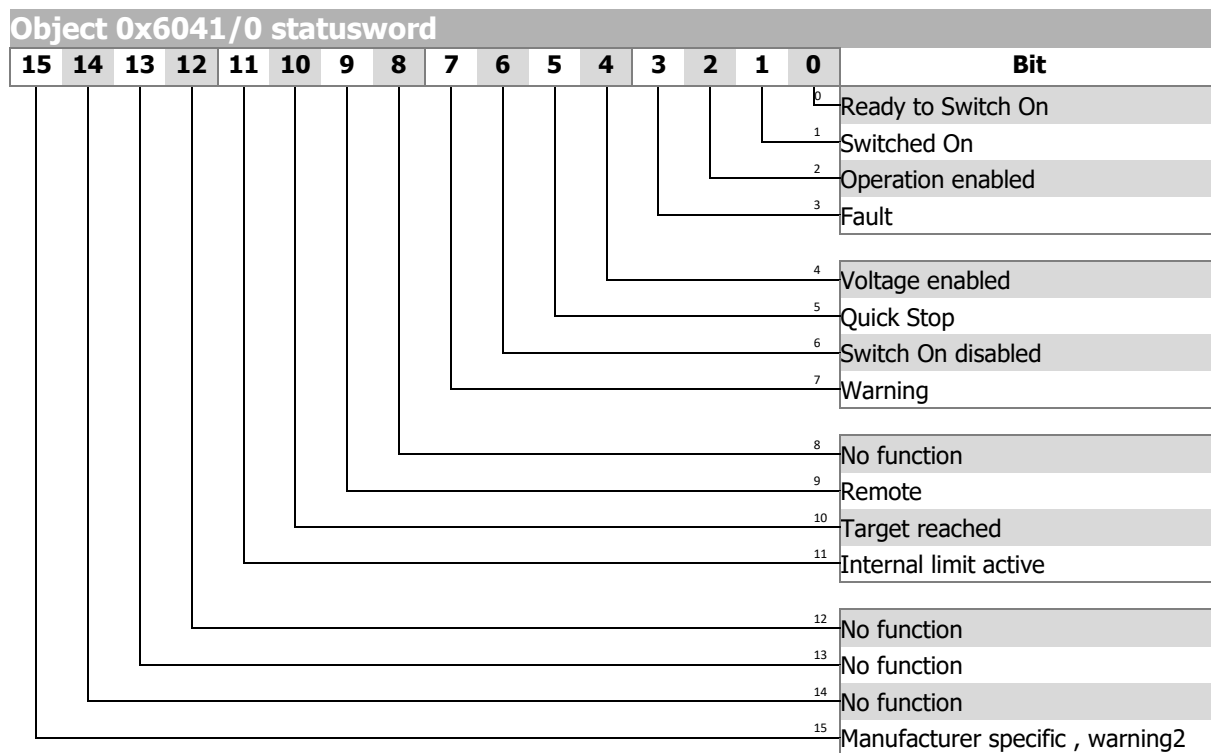
### 12.5.4 0x6041/0 Statusword (status word)

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6041	0	"Statusword"	Unsigned16	ro	Tx	

Object 0x6041/0 *statusword* shows the current state of the frequency inverter.

Object 0x6041/0 *statusword* is linked to the internal parameter *Status word* **411**.

Also refer to Chapters 13.2 "Control via state machine" and 13.1 "Control via contacts/remote contacts". When using CANopen<sup>®</sup> use object 0x6041/0 *statusword* instead of parameter *Status word* **411**.



### 12.5.5 0x6042/0 v/ Target velocity [rpm]

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6042	0	VI Target velocity	Integer16	rw	Rx	0

The object *v/ Target velocity* is the reference speed for the frequency inverter. VI Target velocity is interpreted as a rotational speed with unit  $\text{min}^{-1}$ . The internal reference frequency of the frequency inverter is calculated from the VI Target velocity in  $\text{min}^{-1}$  considering parameter *No. of pole pairs* **373**.

The speed reference handed over with object 0x6042 is set in the frequency inverter using selection "20 - Field Bus Reference" for Parameter *Reference frequency source 1* **475** or *Reference frequency source 2* **492**.



Parameter *No. of pole pairs* **373** has four different datasets.

Upon switching to a motor, object *v/ Target velocity* must be written at least once in order to enable calculation of the reference frequency of the frequency inverter with the right number of pole pairs.

Parameters		Settings	
No.	Object	Min.	Max.
0x6042	VI Target velocity	-32768	32767

### 12.5.6 0x6043/0 v/velocity demand [rpm]

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6043	0	VI velocity demand	Integer16	ro	Tx	

Object *v/ velocity demand* is the output quantity of the ramp function in unit  $\text{min}^{-1}$ . The object has the same notation as object *v/ Target velocity* and can be read as an actual value. For calculation of *v/ velocity demand*, parameter *No. of pole pairs* **373** is considered (in the same way as described for object *v/ Target velocity*).

### 12.5.7 0x6044/0 v/ velocity actual value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6044	0	VI velocity actual value	Integer16	ro	Tx	

Object *v/ velocity actual value* is the current speed of the drive in  $\text{min}^{-1}$ . The object has the same notation as object *v/ Target velocity* and can be read as an actual value. For calculation of *v/ velocity actual value demand*, parameter *No. of pole pairs* **373** is considered (in the same way as described for object *v/ Target velocity*).

### 12.5.8 0x6046/n v/ velocity min max amount (Min./Max. speed)

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6046	0	Highest sub-index supported	Unsigned8	ro	No	2
	1	v/velocity min amount (RPM)	Unsigned32	rw	No	See text
	2	v/velocity max amount (RPM)	Unsigned32	rw	No	See text

Object VI velocity min max amount comprises Subindex 01 = VI velocity min amount and Subindex 02 = VI velocity max amount.

The unit of 0x6046/n *v/ velocity min max amount* is  $\text{min}^{-1}$  (positive values only). The value of 0x6046/n *v/ velocity min max amount* is converted to a frequency value internally, considering parameter *No. of pole pairs* **373** (in dataset 1).

Writing of object 0x6046/1 *v/ velocity min amount* will automatically generate a write instruction for parameter *Minimum frequency* **418** to RAM (→ dataset 5, all datasets in RAM only).

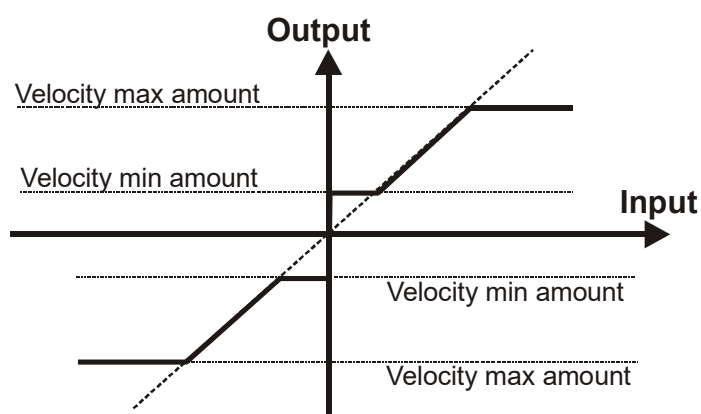
Writing of object 0x6046/2 *v/ velocity max amount* will automatically generate a write instruction for parameter *Maximum frequency* **419** to RAM (→ dataset 5, all datasets in RAM only).

The default setting depends on the motor settings used.



When the reference value specified with object [0x6042 v/ Target velocity](#) is smaller than object value 0x6046/1 *velocity min amount* or greater than 0x6046/2 *velocity max amount*, [0x6042 v/ Target velocity](#) is limited to the relevant values.

No.	Object	Min.	Max.
0x6046/1	v/velocity min amount (RPM)	1	32767 (= 0x7FFF)
0x6046/2	v/velocity max amount (RPM)	1	32767 (= 0x7FFF)



When objects 0x6046/1 or 0x6046/2 are written and a save parameters instruction is generated after that (object [0x1010](#)), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Minimum frequency* **418** and *Maximum frequency* **419**.



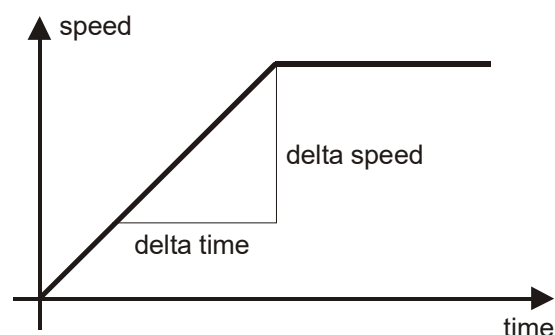
### 12.5.9 0x6048/n v/ velocity acceleration

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6048	0	Highest sub-index supported	Unsigned8	ro	No	2
	1	Delta speed ( $\text{min}^{-1}$ )	Unsigned32	rw	No	0x96
	2	Delta time (sec)	Unsigned16	rw	No	1

With object *v/ velocity acceleration* the change of speed and startup time is set in **velocity mode**. Object *v/ velocity acceleration* comprises *delta speed* in  $\text{min}^{-1}$  and *delta time* in seconds. The frequency gradient during startup is written to parameters *Acceleration clockwise* **420** and *Acceleration anticlockwise* **422** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The values of parameters *Acceleration clockwise* **420** and *Acceleration anticlockwise* **422** are converted to a value in unit frequency/second, considering parameter *No. of pole pairs* **373** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

No.	Object	Min.	Max.
0x6048/1	Delta speed (RPM)	1	32767 (= 0x7FFF)
0x6048/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects 0x6048/1 or 0x6048/2 are written and a save parameters instruction is generated after that (object [0x1010](#)), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Acceleration clockwise* **420** and *Acceleration anticlockwise* **422**.

### 12.5.10 0x6049/n v/ velocity deceleration

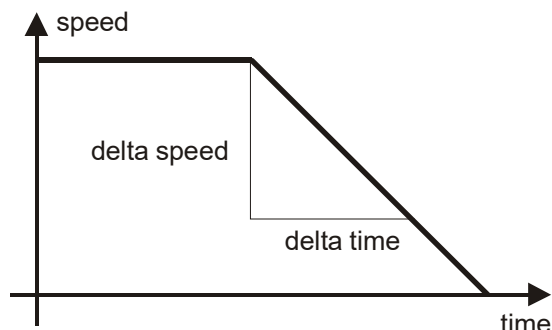
Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6049	0	Highest sub-index supported	Unsigned8	ro	No	2
	1	Delta speed ( $\text{min}^{-1}$ )	Unsigned32	rw	No	0x96
	2	Delta time (sec)	Unsigned16	rw	No	1

With object *v/ velocity deceleration* the change of speed and shutdown time is set. Object *v/ velocity deceleration* comprises *delta speed* in  $\text{min}^{-1}$  and *delta time* in seconds.

The frequency gradient during shutdown is written to parameters *Deceleration clockwise* **421** and *Deceleration anticlockwise* **423** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The values of parameters *Deceleration clockwise* **421** and *Deceleration anticlockwise* **423** are converted to a value in unit frequency/second, considering parameter *No. of pole pairs* **373** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

Parameters		Settings	
No.	Object	Min.	Max.
0x6049/1	Delta speed (RPM)	1	32767 (= 0x7FFF)
0x6049/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects 0x6049/1 or 0x6049/2 are written and a save parameters instruction is generated after that (object [0x1010](#)), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Deceleration clockwise* **421** and *Deceleration anticlockwise* **423**.

### 12.5.11 0x604A/n v/ velocity quick stop

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x604A	0	Highest sub-index supported	Unsigned8	ro	No	2
	1	Delta speed ( $\text{min}^{-1}$ )	Unsigned32	rw	No	0x96
	2	Delta time (sec)	Unsigned16	rw	No	1

With object *v/ velocity quick stop*, you can set the quick stop deceleration. Object *v/ velocity quick stop* comprises speed change in  $\text{min}^{-1}$  and shutdown time in seconds.

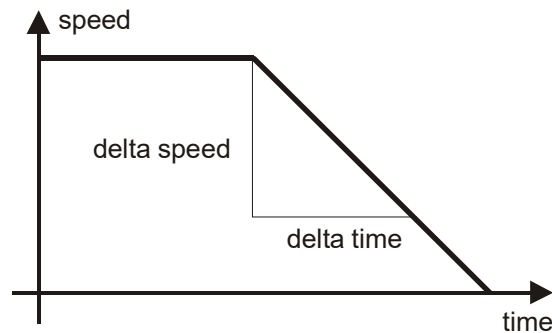
The frequency gradient during shutdown is written to parameters *Emergency Stop Clockwise* **424** and *Emergency Stop Anticlockwise* **425** (dataset 5, all datasets only in RAM). Both parameters are set to the same value. The value of parameters *Emergency Stop Clockwise* **424** and *Emergency Stop Anticlockwise* **425** are converted internally to a value in unit frequency/second, considering parameter *No. of pole pairs* **373** (in dataset 1).

The gradient is changed internally by the change in objects *delta-time* or *delta-speed*.

## Parameters Settings

**No.**  
**Object**  
**Min.**  
**Max.**

0x604A/1	Delta speed ( $\text{min}^{-1}$ )	1	32767 (= 0x7FFF)
0x604A/2	Delta time (sec)	1	65535 (= 0xFFFF)



When objects 0x604A/1 or 0x604A/2 are written and a save parameters instruction is generated after that (object [0x1010](#)), the object values in the non-volatile memory will be saved. When the frequency inverter is switched on the next time, the values set before will be activated again and overwrite the settings of parameters *Emergency Stop Clockwise* **424** and *Emergency Stop Anticlockwise* **425**.

### 12.5.12 0x6060/0 Modes of operation

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6060	0	Modes of operation	Integer8	wo	Rx	2

With object *modes of operation*, the designated operation mode of the inverter is set.

Available values for *modes of operation*:

<i>Modes of operation</i>		
Dec. Hex.	Mode	
2 0x02	–	Velocity mode (Default)
10 0x0A	–	Cyclic Synchronous Torque Mode

Object 0x6060 *modes of operation* is limited like described in the table.

Parameter		Setting	
No.	Object	Min.	Max.
0x6060/0	Modes of operation	2	10   0x0A

For more information, refer to chapter 13 "Control of frequency inverter".

### 12.5.13 0x6061/0 Modes of operation display

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6061	0	Modes of operation display	Integer8	ro	Tx	2

Object *modes of operation display* confirms the permanently set mode of operation set with [0x6060/0 Modes of operation](#) by displaying the value 2.



After setting [0x6060 modes of operation](#), the PLC must wait for this acknowledgement before sending any other command to the inverter.

For more information, refer to chapter 13 "Control of frequency inverter".

### 12.5.14 0x6071/0 Target Torque

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6071	0	Target Torque	Integer16	rw	Rx	0

The object 0x6071 can be used in both supported Modes of Operation.

In Velocity mode:

The value that can be transmitted via object 0x6071 is selectable as source 808 for various parameters (e.g. *FT input buffer percentage* **1381**).

It is also available as operation mode 95 or inverted operation mode 195 (e.g. for parameter *Reference percentage source* **476**) in configurations with torque control (*Configuration* **30** = x30).

In Cyclic Synchronous Torque Mode:

The transmitted value is the reference torque value.

The value 0x3E8 (=1000) is the rated motor torque (100.0 %).



In velocity mode, object 0x6071 is not linked by default to a device function. In order to use object 0x6071, at least one device function must be linked to the object by setting the relevant parameters.

The value range of object 0x6071 is limited from -3000 to 3000 (= -300.0...300.0 %).

Parameters		Settings	
No.	Object	Min.	Max.
0x6071/0	Target Torque	-3000 (= 0xF448)	3000 (= 0x0BB8)
Hexadecimal value 0x6071		Decimal value 0x6071	
0x03E8		1000	
0x0064		100	
0x0001		1	
0xFF18		-1000	
0xFF9C		-100	
0xFFFF		-1	
		Percentage of Target Torque	
0x03E8		100.0	
0x0064		10.0	
0x0001		0.1	
0xFF18		-100.0	
0xFF9C		-10.0	
0xFFFF		-0.1	

### 12.5.15 0x6077/0 Torque actual value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6077	0	Torque actual value	Integer16	ro	Tx	

Object 0x6077 *Torque actual value* shows the actual torque (see parameter *Torque* **224**).

The value 0x3E8 (=1000) is the rated motor torque (100.0 %). Please also note object [0x6071](#).

### 12.5.16 0x6078/0 Current actual value

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6078	0	Current actual value	Integer16	ro	Tx	

Object 0x6078 *Current actual value* shows the actual current value (see parameter *R.m.s current* **211**).

The value 0x3E8 (=1000) is the rated motor current (100.0 %). The rated motor current is set during commissioning in parameter *Rated current* **371**.

### 12.5.17 0x6079/0 DC link circuit voltage

Index	Subindex	Meaning	Data type	Access	Map	Def.-Val:
0x6079	0	DC link circuit voltage	Integer32	ro	Tx	

Object 0x6079 *DC link circuit voltage* shows the actual value of the DC link voltage in mV (see parameter *DC link voltage* **222**).

Value 0x0001 86A0 (=100 000) is equivalent to 100.000 V (three decimal places).

### 12.5.18 0x6502/0 Supported drive modes

Index	Sub-Index	Meaning	Data Type	Access	Map	Def.-Val
0x6502	0	Supported drive modes	Unsigned32	ro	No	

Object 0x6502 *Supported drive modes* displays the supported [0x6060 Modes of Operation](#).

The value 0x0000 0202 means:

Bit 1: "Velocity mode" is supported.

Bit 5: "Cyclic Synchronous Torque mode" is supported.

#### Example:

	COB ID	CB	Index	SI	Data
Read Request	601	40	02 65	00	00 00 00 00
Response	581	43	02 65	00	02 02 00 00

CB: Control byte SI: Sub-Index All values in hexadecimal without leading "0x"

### 13 Control of frequency inverter

The frequency inverter can generally be controlled via three operation modes. The operation modes can be selected via the data set switchable parameter *Local/Remote* **412**.

Parameters		Settings		
No.	Description	Min.	Max.	Factory setting
412	Local/Remote	0	44	44

For operation with EtherCAT®, only operation modes 0, 1 and 2 are relevant. The other settings refer to the control option via the control panel.

Operation mode		Function
0 -	Control via contacts (Chapter 13.1)	The Start and Stop commands as well as the direction of rotation are controlled via digital signals.
1 -	Control via state machine (Chapter 13.2)	The frequency inverter is controlled via the control word.
2 -	Control via remote contacts (Chapter 13.1)	The Start and Stop commands as well as the direction of rotation are controlled via virtual digital signals of the control word.

Parameter *Local/Remote* **412** is dataset switchable, i.e. you can switch between the different operation modes by selecting another data set.

The data set switching can be effected locally via control contacts at the digital inputs of the frequency inverter or via the bus. For data set switching via the bus, parameter *Data set selection* **414** is used.

Parameters		Settings		
No.	Description	Min.	Max.	Factory setting
414	Data set selection	0	5	0

With *Data set selection* **414** = 0, data set switching via contact inputs will be active.

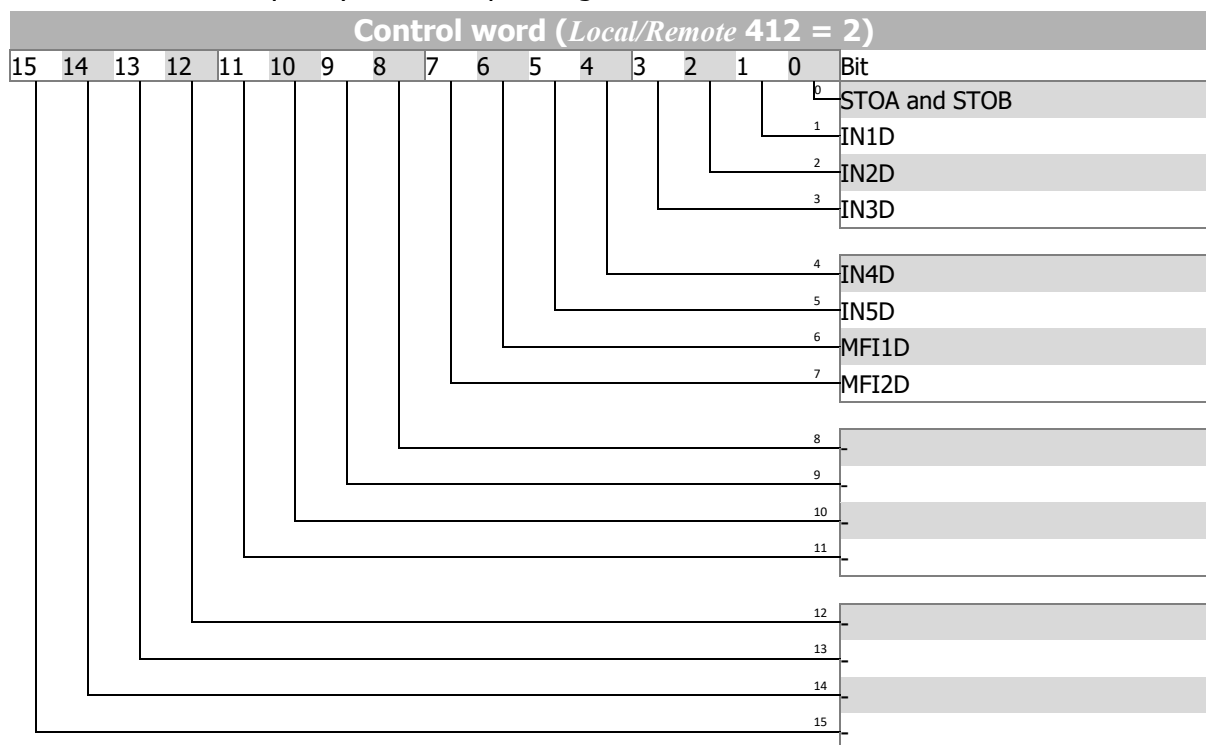
If *Data set selection* **414** is set to 1, 2, 3 or 4, the selected data set is activated and data set switching via the contact inputs is deactivated.

If *Data set selection* **414** is set to 5, data set switching will only take place if the frequency inverter is not enabled.

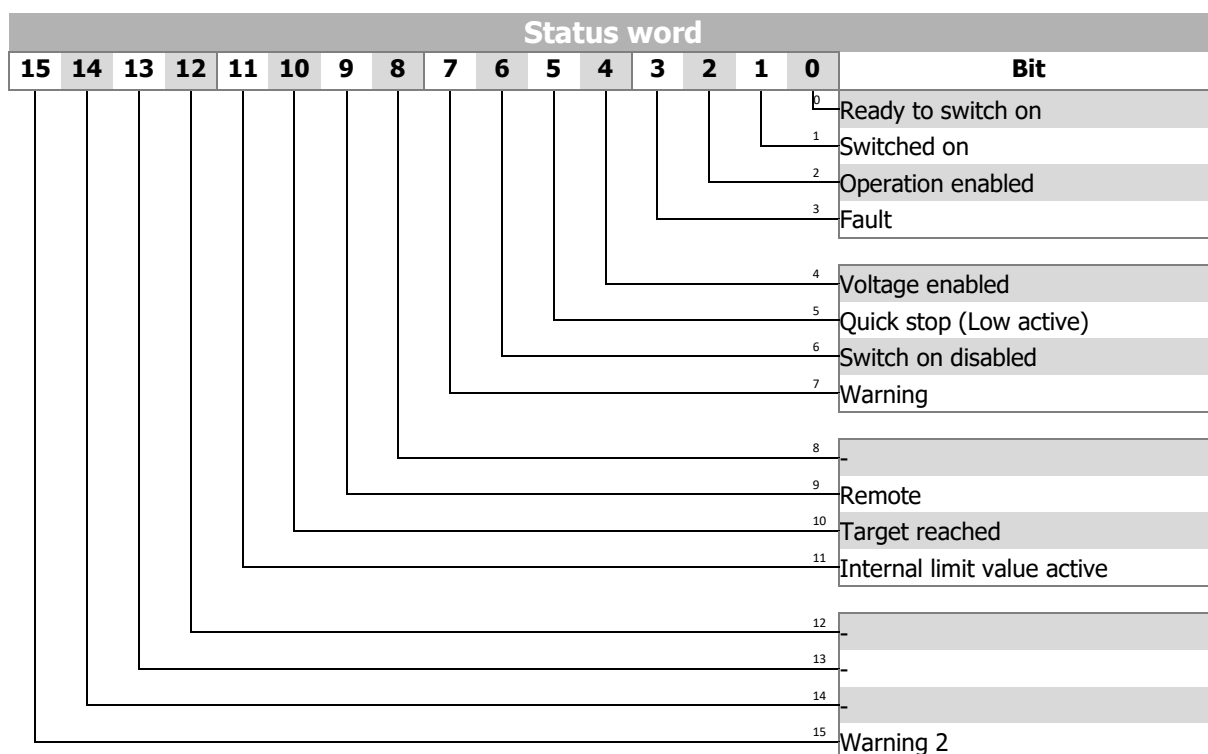
Via parameter *Active data set* **249**, the currently selected data set can be read. *Active data set* **249**, indicates the active data set (value 1, 2, 3 or 4). This is independent of whether the data set switching was done via contact inputs or *Data set selection* **414**.

## 13.1 Control via contacts/remote contacts

In operation mode "Control via contacts" or "Control via remote contacts" (Parameter *Local/Remote* **412** = 0 or 2), the frequency inverter is controlled directly via digital inputs or via the individual bits of the virtual digital signals in the control word. The function of these inputs is described in the frequency inverter operating instructions.



The digital inputs set via the control word can be monitored using parameter *Digital inputs* **250**. Digital input STO will only be displayed if controller release is switched on at STOA and STOB **and** the control word (Bit 0) was set. If the data set switching function is used, please ensure that Parameter *Local/Remote* **412** is set to "2 – Control via remote contacts" is set in all data sets used.



If operation mode "Control via remote contacts" is used, controller release must be turned on at STOA (Terminal X11.3) and STOB (Terminal X13.3) **and** Bit 0 of the control word must be set in order to be able to start the drive.



The frequency inverters support an external 24 V power supply for the frequency inverter control electronics. Even when mains voltage is disconnected, communication between the controller (PLC) and the frequency inverter is still possible.

Bit 4 "Voltage enabled" of the status word shows the current mains power supply status:

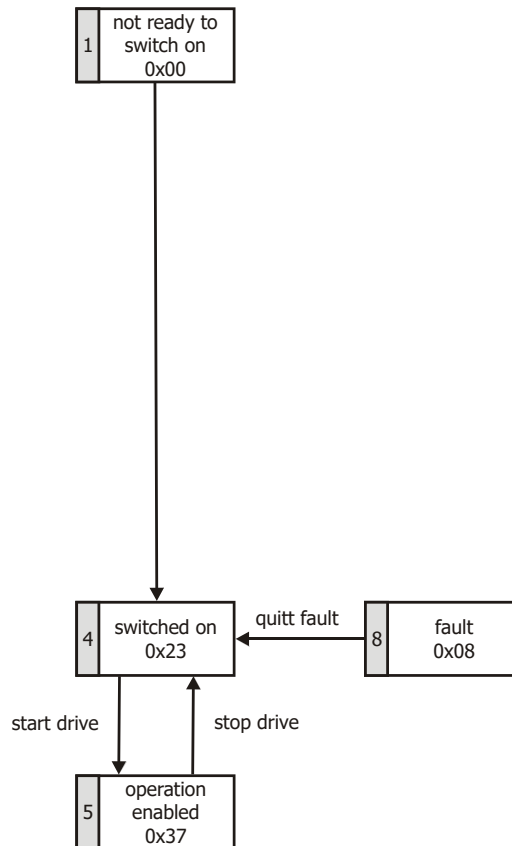
Bit 4 "Voltage enabled" = 0 signals "No mains voltage", starting of drive not possible.

Bit 4 "Voltage enabled" = 1 signals "Mains voltage on", drive ready for starting.



### 13.1.1 Device state machine

#### State machine:



Status word	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0
Switched on	1	0	0	1	1
Operation enabled	1	0	1	1	1
Fault	x	1	x	x	x



"x" means any value.

Bit 7 "**Warning**" can display a device-internal warning message at any time. The current warning is evaluated by reading the warning status with parameter *Warnings* **270**.

Bit 10 "**Target reached**" is set when the specified reference value is reached. In the special case of power failure regulation, the bit is also set when the power failure regulation reaches the frequency 0 Hz (see frequency inverter user manual).

For "Reference value reached" a hysteresis (tolerance range) applies. It can be set via parameter *Reference value reached: Switching hysteresis* **549**(see frequency inverter operating instructions).

Bit 11 "**Internal limit value active**" indicates that an internal limit is active. This may be the current limit, the torque limit or the overvoltage control. All of these limit functions will result in the reference value being left or not reached.

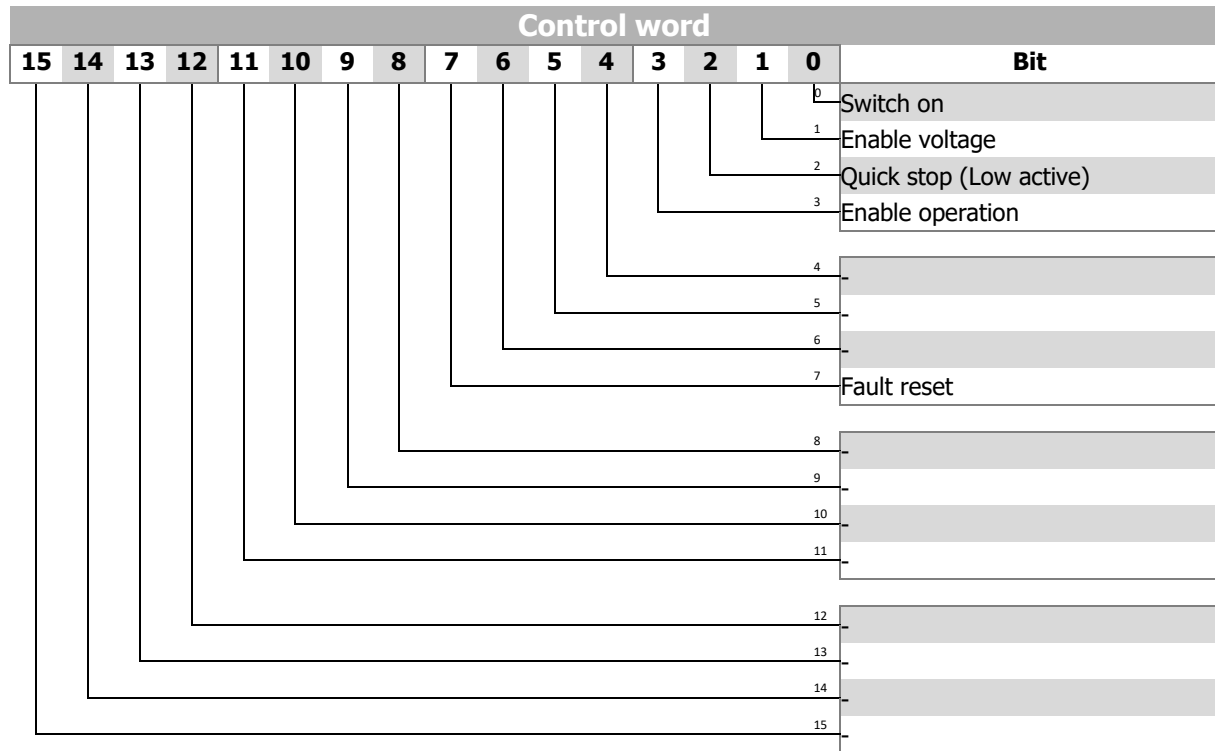
Bit 15 "**Warning 2**" signals a critical operating state which will result in a fault switch-off of the frequency inverter within a short time. This bit is set if there is a delayed warning relating to the motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

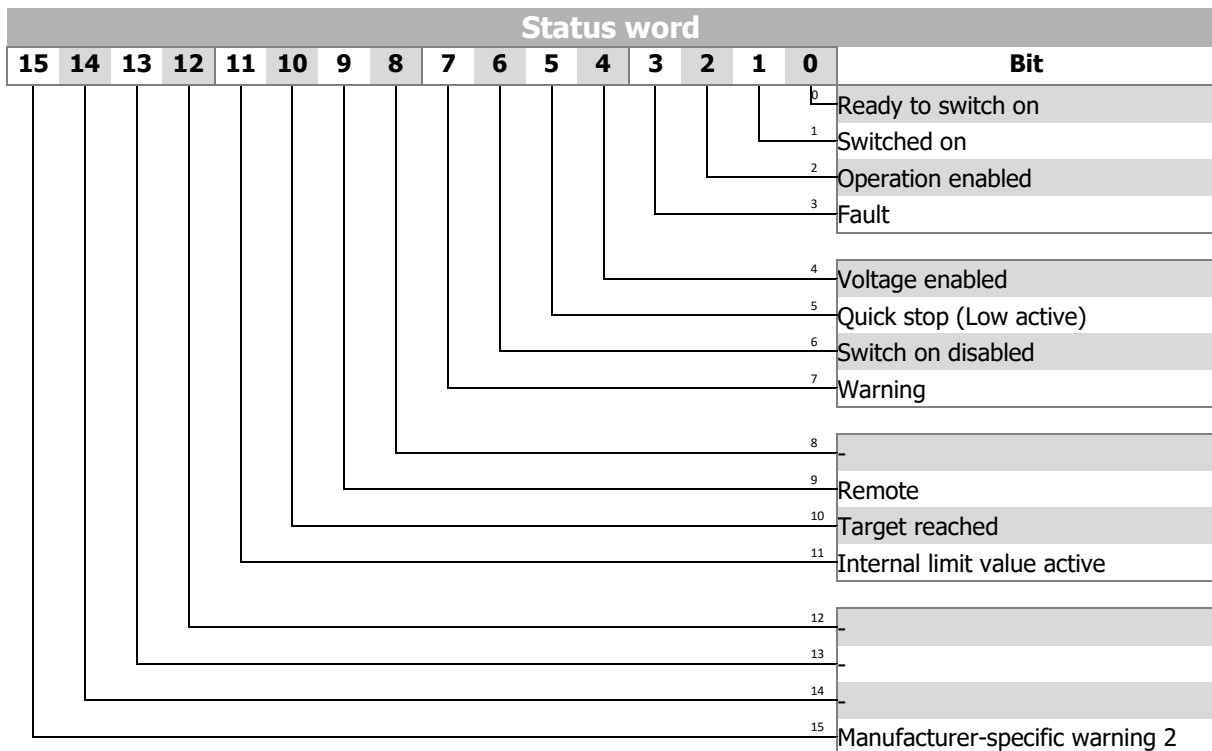
## 13.2 Control via state machine

In this operation mode "Control via state machine" (*Local/Remote* **412** = 1), the frequency inverter is controlled via the *Control word*.

- Transition 4 and 4' to status "Operation enabled" is only possible if the release via STOA and STOB and Start Clockwise or Start Anticlockwise are set.

Object [0x6040](#) *Controlword* is applicable to the frequency inverter if parameter *Local/Remote* **412** is set to "1 – Control via statemachine".





Agile frequency inverters support an external 24 V power supply for the inverter control electronics. Even when mains voltage is disconnected, communication between the controller (PLC) and the frequency inverter is still possible.

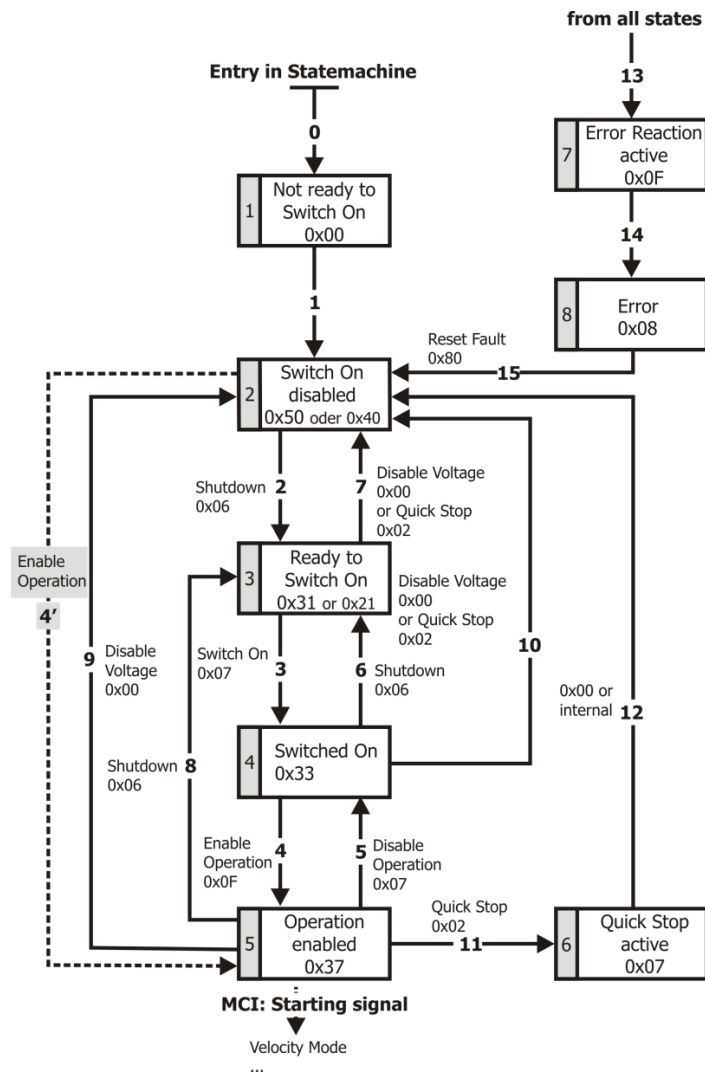
Bit 4 "**Voltage enabled**" of the *Status word* indicates the current state of the mains power supply.

Bit 4 "**Voltage enabled**" = 0 signals "no mains voltage" and the state transition "Ready to switch on" → "Switched on" is **not possible**.

Bit 4 "**Voltage enabled**" = 1 signals "mains voltage switched on" and the state transition "Ready to switch on" → "Switched on" is **possible**.

### 13.2.1 Statemachine diagram

State machine:



**Control word:**

The device control commands are triggered by the following bit patterns in the *Control word*:

#### Control word

Command	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	Transitions
	Reset Fault	Enable Operation	Quick Stop	Enable Voltage	Switch On	
Shutdown	X	X	1	1	0	2, 6, 8
Switch on	X	0	1	1	1	3
Enable operation	X	1	1	1	1	4
Disable voltage	X	X	X	0	X	7, 9, 10, 12
Quick stop	X	X	0	1	X	7, 10, 11
Disable operation	X	0	1	1	1	5
Fault reset	0 ⇒ 1	x	x	x	x	15

"X" means any value.

State transition 3 (command "Switch on" [0x07]) is only processed if bit 4 "Voltage enabled" of the Status word is set.



State Transition 4' will only be processed if Bit 4 "Voltage enabled" of the status word is set.

The frequency inverter can only be controlled via the state machine if the logic linking is true. The logic inputs for Start Clockwise and Start Anticlockwise can be connected directly with "On" or "Off" (parameter *Start clockwise* **68** and *Start anticlockwise* **69**). Digital inputs (STOA and STOB) must be set.

This results in: Release: = (STOA and STOB) AND (Start clockwise OR Start counter-clockwise)

## Status word

The status word indicates the operating status.

Status word						
State	Bit 6	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0
	Switch on disabled	Quick stop	Fault	Operation enabled	Switched on	Ready to switch on
Switch on disabled	1	X	0	0	0	0
Ready to switch on	0	1	0	0	0	1
Switched on	0	1	0	0	1	1
Operation enabled	0	1	0	1	1	1
Quick stop active	0	0	0	1	1	1
Fault reaction active	0	X	1	1	1	1
Fault	0	X	1	0	0	0

"X" means any value.

Bit 7 "**Warning**" can be set at any time. It shows a device-internal warning.

The current warning can be read in the warning status with parameter *Warnings* **270**.

Bit 9 "**Remote**" is set if the operation mode is set to "Control via state machine" (*Local/Remote* **412** = 1) and controller release is turned on.

Bit 10 "**Target reached**" is set when the specified reference value is reached. "Target reached" refers to the object for the reference speed (target speed) [0x6042](#). In the special case of power failure regulation, the bit is also set when the power failure regulation reaches the frequency 0 Hz (see frequency inverter user manual).

For "Reference value reached" a hysteresis (tolerance range) applies. It can be set via parameter *Reference value reached: Switching hysteresis* **549**(see frequency inverter user manual).

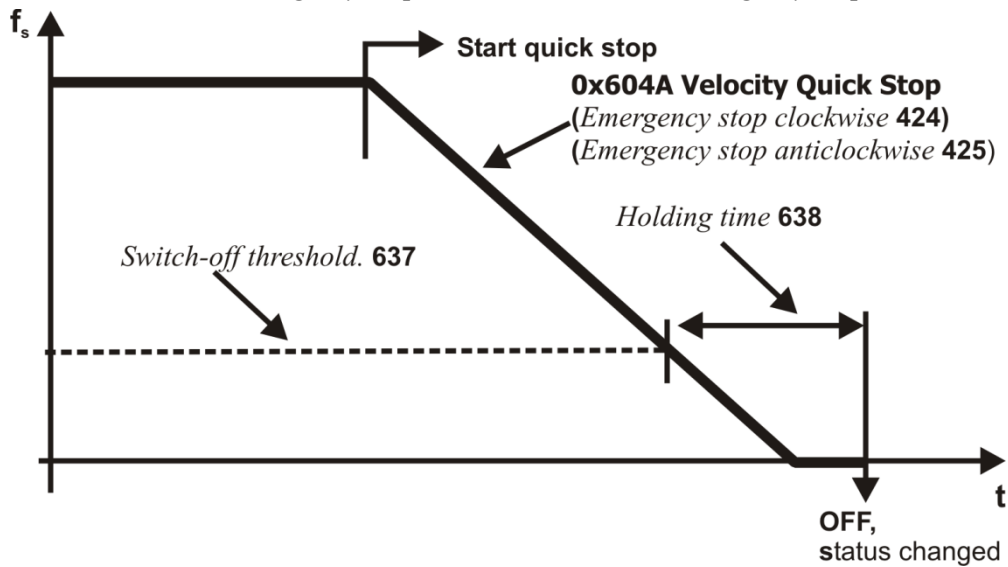
Bit 11 "**Internal limit value active**" indicates that an internal limit is active. This may be the current limit, the torque limit or the overvoltage control. All functions will result in the reference value being left or not reached.

Bit 15 "**Warning 2**" signals a critical operating state which will result in a fault switch-off of the frequency inverter within a short time. This bit is set if there is a delayed warning relating to the motor temperature, heat sink/inside temperature, Ixt monitoring or mains phase failure.

### 13.2.2 Behavior in the case of a quick stop

In this context, parameters *Switch-off threshold stop function*. **637** (Percentage of parameter *maximum frequency* **419**) and *Stop function holding time* **638** (Holding time after passing of threshold) are relevant.

The quick stop ramps are set via object 0x604A/n v/velocity quick stop [0x604A/n v/velocity quick stop](#) or parameters *Emergency Stop Clockwise* **424** and *Emergency Stop Anticlockwise* **425**.



If frequency/speed reaches the value zero during the switch-off time, the drive continues to be supplied with current until the switch-off time has elapsed. This ensures that the drive is at a standstill when the state changes.

### 13.2.3 Behavior in State transition 5 (disable operation)

The *behaviour in transition 5* of the statemachine from "Operation enabled" to "Started" can be configured via parameter *State Transition* **392**.

Parameters		Settings		
No.	Description	Min.	Max.	Factory setting
392	State transition 5	0	2	2


Operation mode		Function
0 -	Coast to stop	Immediate transition from "Operation enabled" to "Switched On", drive coasts to a standstill
1 -	DC brake	Activation of DC brake, at the end of DC deceleration, there is the change from "Operation enabled" to "Switched On"
2 -	Ramp	Transition at normal ramp, when the drive has come to a standstill, there is the change from "Operation enabled" to "Switched On"

Setting 1 "Direct current brake" is only possible with applications with V/f characteristic control (e.g. configuration 110). Other configurations do not support this operation mode.

If the frequency inverter is operated with a configuration which does not support the operation mode Direct Current Brake (e.g. field-oriented control), value "1" cannot be used.

In this case, the operation mode is not offered in the selection menus of the KP500 control unit or the VPlus program.

By default, *State Transition 5* **392** is set to operation mode "2 - Ramp" For configurations with torque control, the default value is "0 - Coast to stop".

If the configuration is changed, the value set for  *State Transition 5* **392** is also changed, if necessary.

If *State Transition 5* **392** was triggered with "1 - DC brake", a new control word will only be accepted after completion of the transition process. The change of state from "Operation enabled" to "Switched On" is done after the *Braking time* **632** parameterized for the DC brake has elapsed.

If parameter *State Transition* **392** = "2 - Ramp" is set, the control word can be set to "Operation enabled" again, while the drive is decelerating. In this way, the drive accelerates to its set reference value again and remains in the state "Operation released".

The change of state from "Operation enabled" to "Switched On" is done after the value has dropped below the set switch-off threshold and the set holding time has elapsed (equivalent to the behavior in the case of a quick stop). In this context, parameters *Switch-off threshold* **637** (percentage of parameter *Maximum frequency* **419**) and *Holding time* **638** (holding time after passing of threshold) are relevant.

### 13.2.4 Available Modes of Operation

The supported modes as per CANopen® Standard DS402 are:

- 2 – Velocity mode [rpm]
- 10 (or 0x0A) – Cyclic Synchronous Torque mode

The actual mode is displayed in [0x6061 Modes of Operation Display](#).

The mode of operation can be switched in any operating state.

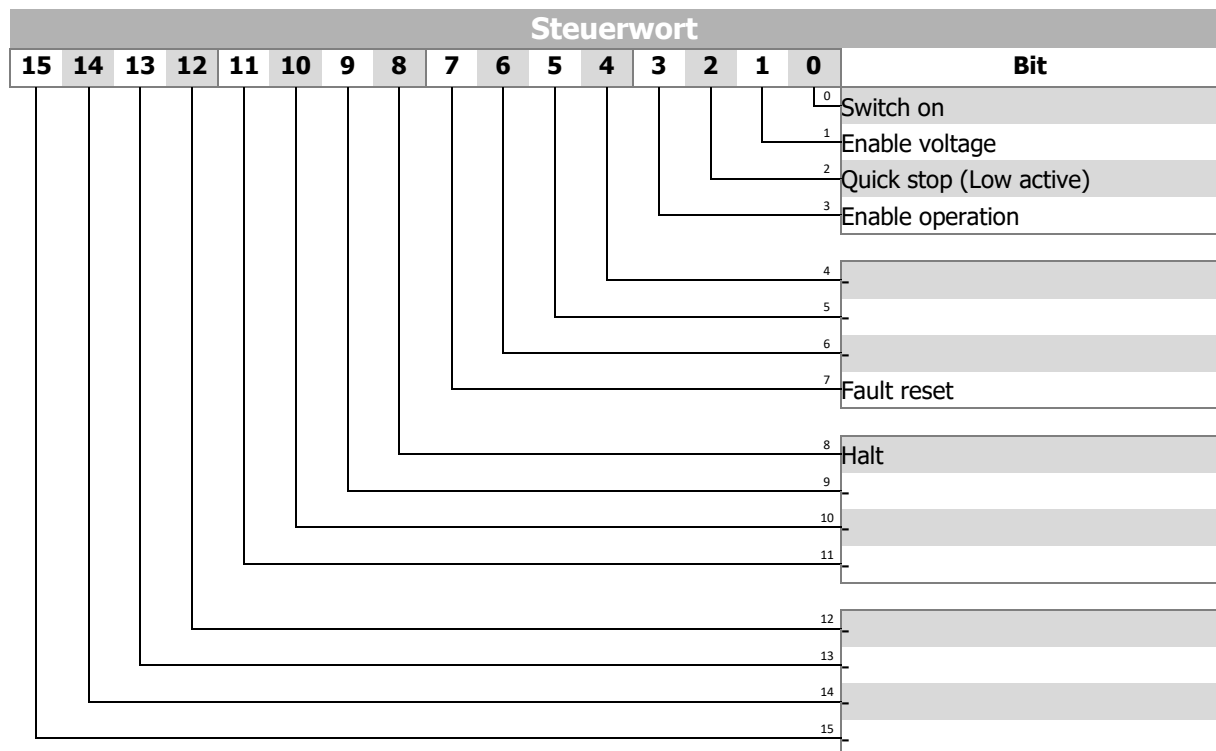
#### 13.2.4.1 Velocity Mode

The Velocity mode [rpm] can be selected via object [0x6060/0 Modes of operation](#) = 2.

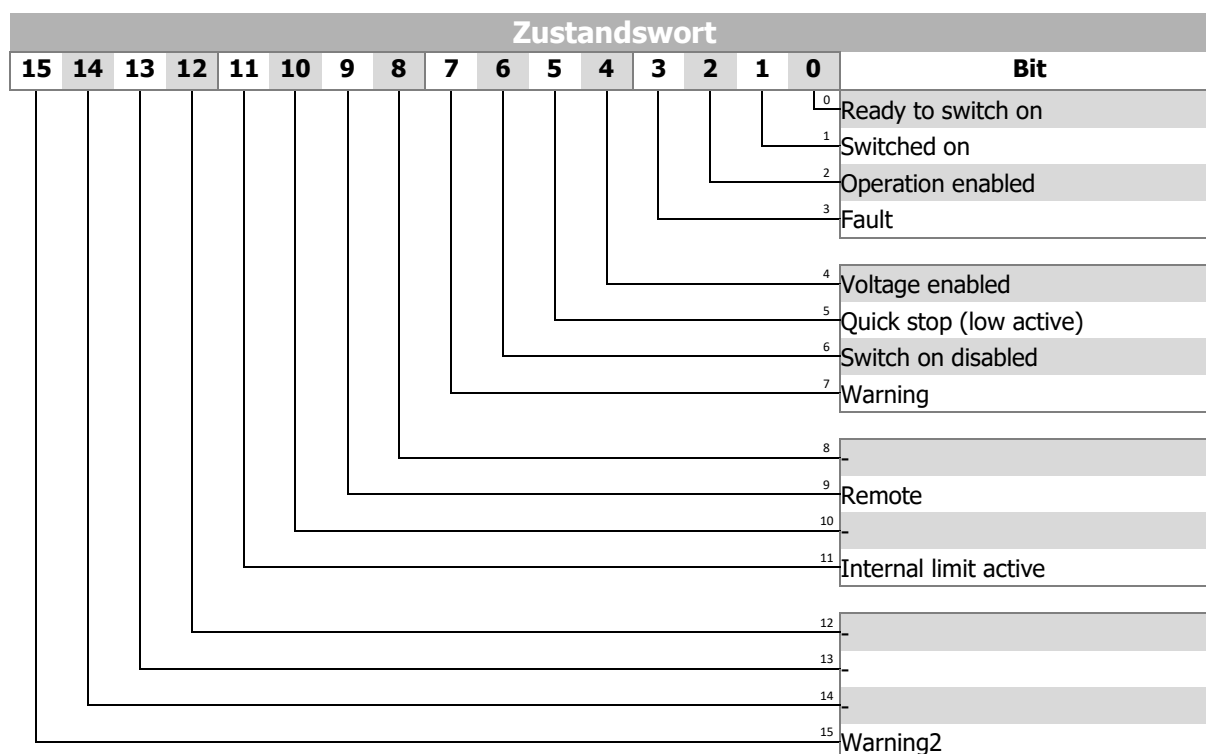
#### Relevant objects:

<a href="#">0x6040</a>	Controlword
<a href="#">0x6041</a>	Statusword
<a href="#">0x6042</a>	Target velocity
<a href="#">0x6043</a>	Velocity demand
<a href="#">0x6044</a>	Control effort v/velocity actual value
<a href="#">0x6046</a>	v/velocity min max amount
<a href="#">0x6048</a>	v/ velocity acceleration
<a href="#">0x6049</a>	v/ velocity deceleration
<a href="#">x604A</a>	v/ velocity quick stop

The Ramp Rise/Fall times are set up via parameters **430...433**.







#### Bit 8: Halt

**HALT = 0** → Drive used reference value.

**HALT = 1** → Stop axis. **(The frequency inverter remains enabled in "Operation enabled" state.)**

#### 13.2.4.1.1 Example sequence

One of the following sequences can be used:

1	Control word =	0x0000	Disable voltage
2	Control word =	0x0006	Shutdown
3	Control word =	0x0007	Switch On
4	Control word =	0x000F	Enable operation

**OR**

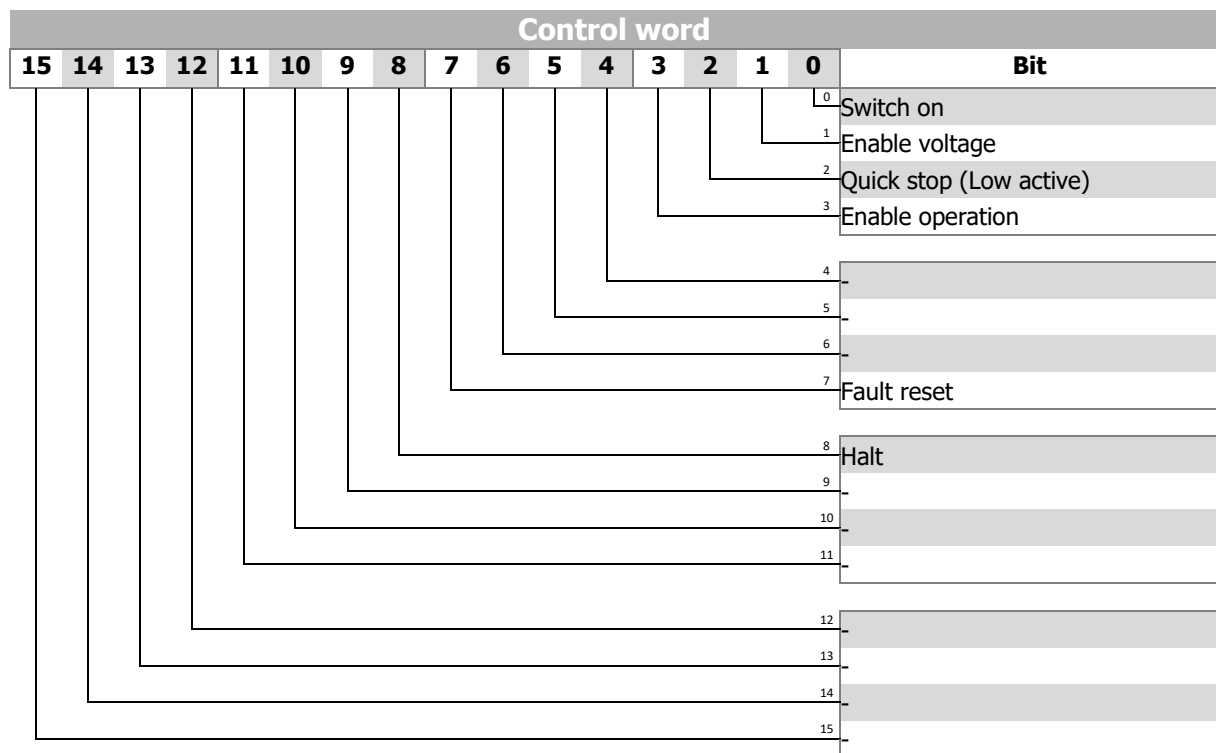
1	Control word =	0x0000	Disable voltage
2	Control word =	0x000F	Enable operation

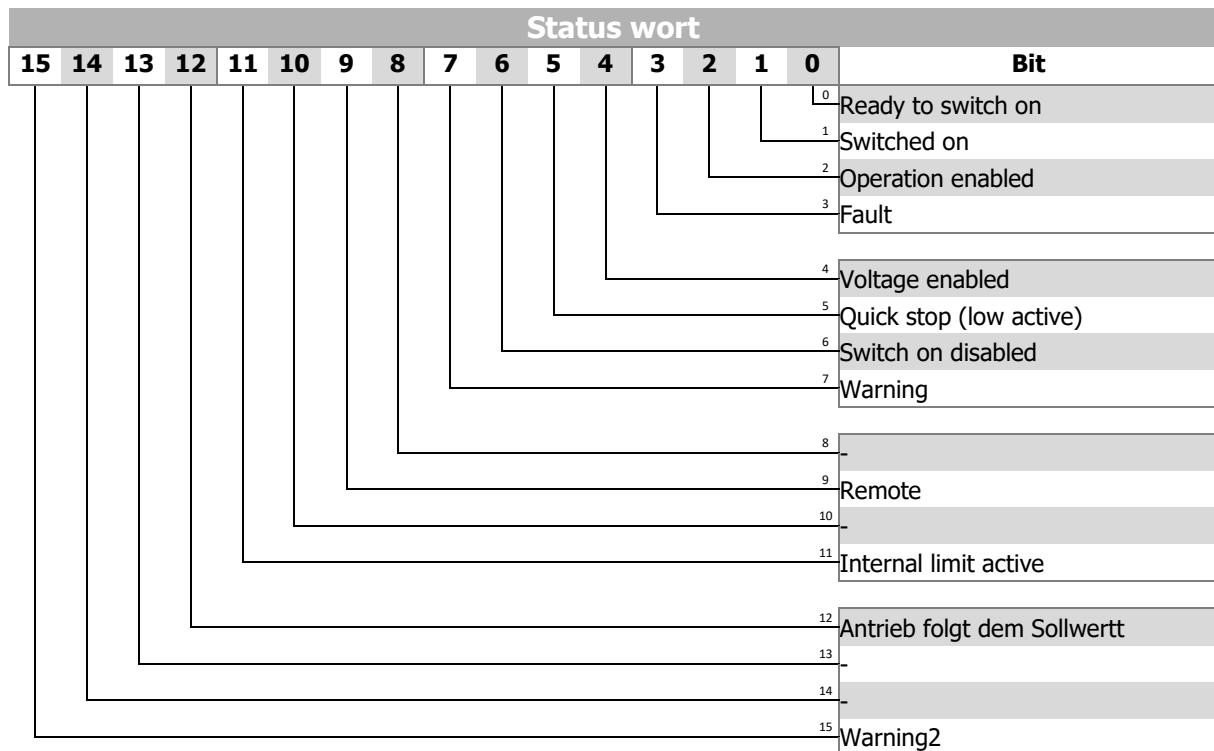
### 13.2.4.2 Cyclic Synchronous Torque Mode

Object [0x6060/0 Modes of operation](#) is permanently set to "2 - velocity mode". Object [0x6061](#) is permanently set to "2 - velocity mode". These settings cannot be changed.

#### Relevant objects:

<a href="#">0x6040</a>	Controlword
<a href="#">0x6041</a>	Statusword
<a href="#">0x6071</a> <a href="#">0x6042</a>	Target velocityTorque
<a href="#">0x6077</a> <a href="#">0x6043</a>	Velocity demandTorque actual value
<a href="#">0x6044</a>	Control effortVI velocity actual value
<a href="#">0x6046</a>	Velocity min max amountVI velocity min max amount
<a href="#">0x6048</a>	Velocity acceleration
<a href="#">0x6049</a>	Velocity deceleration
<a href="#">x604A</a>	Velocity quick stopVI velocity quick stop





### Bit 8: Halt

**HALT = 0** → Drive used reference value.

**HALT = 1** → Stop axis. (The frequency inverter remains enabled in "Operation enabled" state.)



When 0x6060 modes of operation is changed during operation (Control word = 0xn timer) the internal reference value is limited to "Zero". After the change of 0x6060 modes of operation the PLC has to trigger an active change to 0x0F to use in the new mode the new reference value.

#### 13.2.4.2.1 Example sequence

One of the following sequences can be used:

1	Control word =	0x0000	Disable voltage
2	Control word =	0x0006	Shutdown
3	Control word =	0x0007	Switch On
4	Control word =	0x000F	Enable operation

**OR**

1	Control word =	0x0000	Disable voltage
2	Control word =	0x000F	Enable operation

### 13.2.5 Reference value/actual value

The controller (PLC) can define the reference frequency for the frequency inverter via object [0x6042](#) in the used RxPDO and receive the actual value via object [0x6044](#) in the used TxPDO.

The use of the reference/actual value channel depends on the set configuration (control method). The actual value is generated according to the control method use.




The reference value from object [0x6042/0](#) *VI Target velocity* is supplied via the Field Bus reference value.

In the reference frequency channel, via parameter *Reference frequency source 1* **475** or *Reference frequency source 2* **492**, you can select setting "20 – Field bus reference value".

Actual values		
Parameters	Contents	Format
<i>Internal reference frequency</i> <b>228</b>	Total of reference value <i>Reference frequency source 1</i> <b>475</b> and <i>Reference frequency source2</i> <b>492</b> , see operating instructions of Agile frequency inverter.	xxx.xx Hz
<i>Bus reference frequency</i> <b>282</b>	Field Bus reference value from Field Bus	xxx.xx Hz
<i>Ramp reference frequency</i> <b>283</b>	Current reference frequency of ramp	xxx.xx Hz

## 14 Parameter List

The parameter list is structured according to the menu branches of the control unit. For better overview, the parameters are marked with pictograms:

-  The parameter is available in the four data sets.
-  The parameter value is set by the SET-UP routine
-  This parameter cannot be written when the frequency inverter is in operation.








### 14.1 Actual values

No.	Description	Unit	Indication range	Chapter
<b>Actual values of frequency inverter</b>				
<a href="#">228</a>	<a href="#">Internal Reference Frequency</a>	Hz	-1000,00 ... 1000,00	13.2.4.1.1
<a href="#">249</a>	<a href="#">Active Data Set</a>	-	1 ... 4	13
<a href="#">260</a>	<a href="#">Actual error</a>	-	0 ... 0xFFFF	12.5.2 15.5
<a href="#">270</a>	<a href="#">Warnings</a>	-	0 ... 0xFFFF	15.3
<a href="#">274</a>	<a href="#">Application Warnings</a>	-	0 ... 0xFFFF	15.4
<a href="#">282</a>	<a href="#">Reference Bus Frequency</a>	Hz	-1000.00 ... 1000.00	13.2.4.1.1
<a href="#">283</a>	<a href="#">Reference Ramp Frequency</a>	Hz	-1000,00 ... 1000,00	13.2.4.1.1
<a href="#">411</a>	<a href="#">Status word</a>	-	0 ... 0xFFFF	13
<a href="#">1443</a>	<a href="#">Node-State (NMT)</a>	-	0 ... 127	11.7
<a href="#">1453</a>	<a href="#">OS SyncSource Act</a>	-	Selection	11.8



Parameters *Current error* **260**, *Warnings* **270** and *Application warnings* **274** are only accessible via objects 0x2nnn Manufacturer objects. They cannot be addressed via the VPlus control software or the control panel.

### 14.2 Parameters

No.	Description	Unit	Setting range	Factory setting	Chapter
<b>Field Bus</b>					
<a href="#">388</a>	<a href="#">Error Behavior</a>	-	Selection	1 - Fault	10, 12.5.1
<b>Rated motor values</b>					
 <a href="#">373</a>	<a href="#">No. of Pole Pairs</a>	-	1 ... 24	2	12.5
<b>Bus control</b>					
<a href="#">392</a>	<a href="#">State transition 5</a>	-	Selection	2 - Ramp	<b>Fehler! Verweis- quelle konnte nicht ge- funden werden.</b>
 <a href="#">410</a>	<a href="#">Control word</a>	-	0 ... 0xFFFF	0	13
 <a href="#">412</a>	<a href="#">Local/Remote</a>	-	Selection	4 - Ctrl. Keypad/Contacts	13
<b>Data set switching</b>					
<a href="#">414</a>	<a href="#">Data set selection</a>	-	0 ... 4	0	13
<b>Frequency ramps</b>					
 <a href="#">420</a>	<a href="#">Acceleration (Clockwise)</a>	Hz/s	0.00 ... 9999.99	5.00	12.5.9
 <a href="#">421</a>	<a href="#">Deceleration (Clockwise)</a>	Hz/s	0.01 ... 9999.99	5.00	12.5.10, 12.5.11
 <a href="#">422</a>	<a href="#">Acceleration Anticlockwise</a>	Hz/s	-0.01 ... 9999.99	-0.01	12.5.9
 <a href="#">423</a>	<a href="#">Deceleration Anticlockwise</a>	Hz/s	-0.01 ... 9999.99	-0.01	12.5.10, 12.5.11

No.	Description	Unit	Setting range	Factory setting	Chapter
<a href="#">424</a>	<a href="#">Emergency Stop Clockwise</a>	Hz/s	0.01 ... 9999.99	5.00	12.5.11, <b>Fehler! Verweis- quelle konnte nicht ge- funden werden.</b>
<a href="#">425</a>	<a href="#">Emergency Stop Anticlockwise</a>	Hz/s	0.01 ... 9999.99	5.00	12.5.11, <b>Fehler! Verweis- quelle konnte nicht ge- funden werden.</b>

#### Digital outputs

<a href="#">549</a>	<a href="#">Reference Value Reached: Tolerance Band</a>	%	0.01 ... 20.00	5.00	13.1, 13.2
---------------------	---	---	----------------	------	------------

#### Stopping behavior

<a href="#">637</a>	<a href="#">Switch-Off Threshold Stop Function</a>	%	0.0 ... 100.0	1.0	<b>Fehler! Verweis- quelle konnte nicht ge- funden werden., Fehler! Verweis- quelle konnte nicht ge- funden werden.</b>
<a href="#">638</a>	<a href="#">Holding Time Stop Function</a>	s	0.0 ... 200.0	1.0	<b>Fehler! Verweis- quelle konnte nicht ge- funden werden., Fehler! Verweis- quelle konnte nicht ge- funden werden.</b>

#### CANopen® Mux/Demux

<a href="#">1420</a>	<a href="#">CANopen Mux Input Index (write)<sup>1)</sup></a>	-	EEPROM: 0 ... 16 RAM: 17 ... 33	1	12.4.5
<a href="#">1421</a>	<a href="#">CANopen Mux Input Index (read)<sup>1)</sup></a>	-	EEPROM: 0 ... 16 RAM: 17 ... 33	1	12.4.5
<a href="#">1422</a>	<a href="#">CANopen Mux Input</a>	-	Selection	7 - Off	12.4.5

#### CANopen®

<a href="#">1423</a>	<a href="#">CANopen Percentage Actual Value Source</a>	-	Selection	52 - analog input MF11A	12.4.7
<a href="#">1451</a>	<a href="#">OS SyncTime</a>	-	700...900 us	800 us	9.10
<a href="#">1452</a>	<a href="#">OS SyncSource</a>	-	Selection	52 - analog input MF11A	11.8

1)

non-volatile (fixed parameterization)		Volatile:	
0:	all indexes in EEPROM	17:	all indexes in RAM
1...16	One index in EEPROM	18...33	One index 1...16 in RAM



Setting "0" for *CANopen Mux input index (write)* **1420** changes all data in EEPROM and/or RAM.



Parameter *Data set selection* **414** is only accessible via Manufacturer objects 0x2nnn. It cannot be addressed via the VPlus control software or the control panel.

For other parameters, refer to the Operating Instructions.

## 15 Annex

### 15.1 Control Word overview

The following table provides an overview of the functions of the **control word** bits if Control via state machine (*Local/Remote* **412** = "1 - Control via statemachine").

Bit	<b>AGL Control word</b>
0	Switch On
1	Enable Voltage
2	Quick Stop (Low Active)
3	Enable Operation
4	
5	
6	
7	Reset Fault
8	
9	
10	
11	
12	
13	
14	
15	

### 15.2 List of status words

The following table provides an overview of the functions of the **status word** bits if Control via state machine (*Local/Remote* **412** = "1 - Control via statemachine").

Bit	<b>AGL Status word</b>
0	Ready to Switch On
1	Switched On
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick Stop (Low active)
6	Switch On Disabled
7	Warning
8	
9	Remote
10	Target reached
11	Internal limit active
12	
13	
14	
15	Warning 2



## 15.3 Warning messages

The different control methods and the hardware of the frequency inverter include functions for continuous monitoring of the application. In addition to the messages documented in the frequency inverter user manual, further warning messages are activated by the Field Bus communication.

The bit-coded warning reports are issued via parameter *Warnings* **270** according to the following pattern:

Parameter *Warnings* **269** indicates the warnings as plain text in the control panel and the VPlus PC software.

Use parameter *Warnings* **270** in order to read the warning messages via Field Bus.

Warning messages		
Bit no.	Warning code	Description
0	0x0001	Warning Ixt
1	0x0002	Warning Short Term - Ixt
2	0x0004	Warning Long Term - Ixt
3	0x0008	Warning Heat sink Temperature Tc
4	0x0010	Warning Inside Temperature Ti
5	0x0020	Warning Limit
6	0x0040	Warning Init
7	0x0080	Warning Motor Temperature
8	0x0100	Warning Mains Failure
9	0x0200	Warning Motor Protective Switch
10	0x0400	Warning Fmax
11	0x0800	Warning Analog Input MFI1A
12	0x1000	Warning Analog Input MFI2A
13	0x2000	Warning System bus
14	0x4000	Warning Udc
15	0x8000	Warning <i>Application warning status</i> <b>273</b>



The meaning of the individual warnings are described in detail in the Operating Instructions.

## 15.4 Application warning messages

When the highest bit of the warning message is set, an "Application warning message" is present. The application warning messages are bit-encoded as per the following pattern via parameter *Application warnings* **274**. Parameter *Application warnings* **273** indicates the warnings as plain text in the control panel and the VPlus PC control software.

Use parameter *Application warnings* **274** in order to read the warning messages via Field Bus.

Application warning messages			
Bit no.	Warning code	Description	
0	0x0001	BELT	0
1	0x0002	(reserved)	1
2	0x0004	(reserved)	2
3	0x0008	(reserved)	3
4	0x0010	(reserved)	4
5	0x0020	(reserved)	5
6	0x0040	SERVICE	6
7	0x0080	User 1	7
8	0x0100	User 2	8
9	0x0200	(reserved)	9
10	0x0400	(reserved)	10
11	0x0800	(reserved)	11
12	0x1000	(reserved)	12

13	0x2000	(reserved)	13
14	0x4000	(reserved)	14
15	0x8000	(reserved)	15



For detailed descriptions of the application warnings, refer to the Operating Instructions.

## 15.5 Error messages

The error code stored following a fault comprises the error group FXX (high-byte, hexadecimal) and the code YY (low-byte, hexadecimal).

Communication error			
Key		Meaning	
F27	01	CRC-Error in communication EtherCAT® module/inverter	
	02	Timeout-Error in communication EtherCAT® module/inverter	
	14	Communication loss to PLC	

The current error can be read via parameter *Current error* **260**.

Parameter *Current error* **259** indicates the current error as plain text in the control panel and the VPlus PC control software.

In addition to the error messages mentioned, there are other error messages specified in the Operating Instructions.

## 15.6 Conversions

The speeds/frequencies can be converted to other speed formats using the formulas in this chapter:

Frequency [Hz] into	speed [1/min]	See Chapter 15.6.2
Speed [1/min] in	Frequency [Hz]	See Chapter 15.6.1

### 15.6.1 Speed [1/min] into frequency [Hz]

$$f [\text{Hz}] = \frac{n[\text{min}^{-1}] \times \text{No. of pole pairs (P. 373)}}{60}$$

### 15.6.2 Frequency [Hz] into speed [1/min]

$$n[\text{rpm}] = \frac{f [\text{Hz}] \times 60}{\text{No. of pole pairs (P. 373)}}$$

## 15.7 Object support in software versions and XML files

Support of EtherCAT® was extended in the firmware in various steps. The following table describes from which software version the relevant objects are supported and indicates the relevant XML file. Added or edited objects are marked in light blue.



Long object names are abbreviate in the table for reasons of clarity.

Firmware	6.1.0	6.2.0
XML	BVAGL610_V2.xml	BVAGL620.xml
<a href="#">0x1000</a> Device Type	x	x
<a href="#">0x1001</a> Error register	x	x
<a href="#">0x1008</a> Manuf. Device name	x	x
<a href="#">0x1009</a> Manuf. Hardw. Vers.	x	x
<a href="#">0x100A</a> Manuf. Softw. Vers.	x	x
<a href="#">0x1010</a> Store parameters	x	x
<a href="#">0x1011</a> Restore parameters	x	x
<a href="#">0x1018</a> Identity object	x	x
<a href="#">0x1600</a> RxPDO1 map. param.	x	x
<a href="#">0x1601</a> RxPDO2 map. param.	x	x
<a href="#">0x1602</a> RxPDO3 map. param.	x	x
<a href="#">0x1A00</a> TxPDO1 map. param.	x	x
<a href="#">0x1A01</a> TxPDO2 map. param.	x	x
<a href="#">0x1A02</a> TxPDO3 map. param.	x	x
<a href="#">0x3001</a> Digital In actual values	x	x
<a href="#">0x3002</a> Digital Out act. values	x	x
<a href="#">0x3003</a> Digital Out set values	x	x
<a href="#">0x3004</a> Boolean Mux	x	x
<a href="#">0x3005</a> Boolean DeMux	x	x
<a href="#">0x3006</a> Percentage Set value	x	x
<a href="#">0x3007</a> Percentage Act. value 1	x	x
<a href="#">0x6007</a> Abort connect. option c.	x	x
<a href="#">0x603F</a> Error code	x	x
<a href="#">0x6040</a> Controlword	x	x
<a href="#">0x6041</a> Statusword	x	x
<a href="#">0x6042</a> VI Target velocity	x	x
<a href="#">0x6043</a> VI velocity demand	x	x
<a href="#">0x6044</a> VI velocity actual value	x	x
<a href="#">0x6046</a> VI velocity min max amount	x	x
<a href="#">0x6048</a> VI Velocity acceleration	x	x
<a href="#">0x6049</a> VI Velocity deceleration	x	x
<a href="#">0x604A</a> VI velocity quick stop	x	x
<a href="#">0x6060</a> Modes of Operation	x	x
<a href="#">0x6061</a> Modes of Op. display	x	x
<a href="#">0x6071</a> Target Torque	x	x
<a href="#">0x6077</a> Torque Actual value	x	x
<a href="#">0x6078</a> Current Actual value	x	x
<a href="#">0x6079</a> DC link circuit voltage	x	x
<a href="#">0x6502</a> Supported Drive modes	x	x

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